SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY, 1931.

GENERAL PHYSICS.

322. Harmonic Analysers. J. Bartels. *Gerlands Beitr. z. Geophys.* 28. 1–3. *pp.* 1–10, 1930.—Some formulæ and a table are given for harmonic analysis of equidistant ordinates, especially for the use of mechanical analysers. The corrections for the use of differences are derived. A subsidiary instrument for analysers is described. AUTHOR.

323. Improved Victor-Meyer Molecular-Weight Apparatus. Mildred M. Hicks-Bruun. *Bureau of Standards, J. of Research,* 5. *pp.* 575–583, *Sept.,* 1930.—The Victor-Meyer molecular-weight apparatus for determining vapour density is modified to permit measurements at two pressures, one atmosphere and one-half atmosphere. By using Berthelot's method of limiting density most of the effects of departure from the perfect gas laws are eliminated. Experiments with hydrocarbons gave molecular weights differing from the theoretical by the following maximum deviations: benzene, 16 experiments, 0·2 %; hexane, 4 experiments, 0·24 %; naphthalene, 4 experiments, 0·06 %. AUTHOR.

324. Influence of Earth's Magnetic Field on the Time of Oscillation of the Nickel-Steel Pendulum. M. Rössiger. *Zeits. f. Instrumentenk.* 50. *pp.* 551–552, *Sept.,* 1930.—Measurements were made with an astatic torsion galvanometer having optical magnification in field strengths from 0·18 to 1·5 gauss and the resulting decrease of the period of oscillation calculated. The permeability was constant up to 1·5 gauss. In a field of 0·45 gauss the decrease of the time of oscillation is $7 \cdot 7 \times 10^{-7}$ sec. Since corrections in the field can be calculated exactly only to 10 %, the advantage of the thermal properties of invar and similar alloys will scarcely be given up, and for measurements aspiring to an accuracy of 1×10^{-7} sec., the steel pendulum is retained. R. S. R.

325. Viscosity and Inner Friction of Solid Bodies. B. Gutenberg and H. Schlechtweg. *Phys. Zeits.* 31. *pp.* 745–752, *Aug.* 15, 1930.—In the older literature the terms viscosity (*Zähigkeit*) and inner friction are used indiscriminately, and the authors now point out that these terms include two completely distinct processes: The first, formulated clearly by Jeffreys [see Abstract 733 (1917)], involves a modification of the pure elasticity theory since bodies are too yielding; the second depends upon excessive rigidity, the particles of bodies being over rigidly united with each other so that the motion demanded by the theory of elasticity is retarded. The present paper deals more particularly with the conception of inner friction, terms being carefully explained. When a substance flows the term viscosity (*Zähigkeit*) is used and new relationships are developed by means of the tensor calculus. A table of viscosity coefficients for several common substances is included, also for resistance to flow (strength) and for inner friction (for the metals, Pt, Ni, Fe, Cu, Ag, Au, Al, Sn and Zn). The paper concludes with an application of the results to the earth. H. H. Ho.

326. Viscosities of Aqueous Solutions of Organic Substances. Part II. H. M. Chadwell and B. Asnes. *Am. Chem. Soc., J.* 52. *pp.* 3507–3518, *Sept.*, 1930.—The viscosities of aqueous solutions of diethyl ether, methyl acetate, ethyl acetate, urethan and urea are determined at 10° C., and of urea solutions at 5°, 15°, 20° and 25° C. also. Aqueous solutions of urea do not possess viscosities less than water at any concentrations from 1·6 to 19·5 %, although the curvature of the viscosity-concentration curve is found to be positive. These solutions are not exceptions to the rule that aqueous solutions of non-electrolytes possess a viscosity greater than that of water, irrespective of the viscosity of the solute. The effect of depolymerisation of water is no more apparent at 10° than at 25° C., except possibly in urea solutions. The results are discussed from the point of view of compound formation and orientation of polar molecules. [See Abstracts 1 (1926) and 15 (1927).] A. J. M.

327. Temperature Variation of the Viscosity of Liquids and its Theoretical Significance. M. P. V. Iyer. *Indian Journ. Phys.* 5. *pp.* 371–383, *Sept.* 15, 1930.—Raman's formula, suggested in 1923 [see Abstract 1295 (1923)] for the variation of viscosity η with temperature T, in the form $\eta = Ae^{B/T}$, is applied to measurements relating to 87 liquids, including hydrocarbons, alcohols, ethers, aldehydes and ketones, acids, chlorides, etc. Except in a few liquids, theoretical and experimental values of η are in good agreement. It is shown that the value of the constant A is comparable with the viscosity of the substance in the vapour state, whilst B, in many cases, is of the same order of magnitude as W/R, W denoting the molecular heat of fusion of the substance and R the gas constant. J. S. G. T.

328. Hydrodynamic Boundary Problem. C. W. Oseen. *Zeits. f. angew. Math. u. Mechanik*, 10. *pp.* 314–326, *July–Aug.*, 1930.—The hydrodynamic problem is now treated as the boundary problem involved in the linearised Navier-Stokes differential equations. From the work of Fredholm it appears probable that the solution of the special case where the boundary is a plane is to be found in a regular integral equation. The subject-matter is dealt with as follows: the extended Stokes approximation for stationary motion applied first to the two-dimensional and then to the three-dimensional problem; the Stokes approximation for non-stationary motion; solution of the boundary problem for stationary motion according to Odqvist and Faxén; solution of the problem of the circular cylinder according to Bairstow, Cave and Lang, Filon, and Faxén respectively. The paper is entirely mathematical. H. H. Ho.

329. Application of the Oseen Hydrodynamical Equations to the Calculation of Liquid Flow under the Action of External Forces. J. M. Burgers. *Zeits. f. angew. Math. u. Mechanik.* 10. *pp.* 326–334, *July–Aug.*, 1930.—In this paper the Oseen hydrodynamical equations are shown to be especially suitable for the systematic study of the motion of liquids under the action of external forces, and their solution by the method of successive approximation is developed. Numerous examples are given including the cases of stationary motion, the higher Reynolds numbers (vanishing viscosity), line motion, motion approaching turbulence, the influence of forces of the second order, and the problem of the determination of body form (by means of which a definite force system could be deduced for the liquid), although this problem cannot yet be completely solved. The paper is entirely mathematical. H. H. Ho.

330. Flow About a Body in a Compressible Fluid. G. J. Taylor. *Zeits. f. angew. Math. u. Mechanik.* 10. *pp.* 334–346, *July–Aug.*, 1930.—In this paper the effect of compressibility in turbulence-free flow is considered. In order to compare the results with those obtained from observation, the special case is taken of the effect of compressibility on the flow about an aeroplane wing of the Joukewsky type, the circulation being so chosen that the velocity is zero at the edge. The experimental results are first discussed, then follow Rayleigh's solution, the method of mechanical solution and comparison with Rayleigh's method, application to the circular cylinder and then to the aeroplane wing, an empirical criterion for the cessation of convergence, further experiments for the determination of limits to the maximum velocity in turbulence-free motion, limits for the maximum velocity of an air stream about a circular cylinder, and the case of stationary motion. The paper is entirely mathematical. H. H. Ho.

331. Wake in Fluid Flow Past a Solid. H. Jeffreys. *Roy. Soc., Proc.* 128. *pp.* 376–393, *Aug.* 5, 1930.—To combine the correct boundary conditions with reasonable arbitrariness in the motions of solids in contact with fluid, it is necessary to have greater flexibility in the differential equations that hold in the body of the fluid. This is provided by the fact that in the real fluid the stress is no longer exactly normal to the surface-element; this fact introduces into the equations of motion the viscosity terms, which raise the order of the equations by unity and make it possible to satisfy the boundary conditions. From comprehensive mathematical treatment, the author concludes that the vortices generated in three-dimensional flow, even when the two-dimensional flow is a useful first approximation to the facts in a limited region, do not form a system drifting steadily down-stream, and that there is no simple extension of the Kármán street to three dimensions. When the solid is approximately one of revolution, with its axis along the general direction of flow, there is a quasi-steady solution in terms of a series of vortex rings drifting down-stream; but this is unstable, and in any case is not an analogue of the Kármán street. The actual motion in the wake is probably completely turbulent. H. H. Ho.

332. Flow Behind Circular Cylinders in Channels of Different Breadths. L. Rosenhead and M. Schwabe. *Roy. Soc., Proc.* 129. *pp.* 115–135, *Sept.* 3, 1930.—Schwabe carried out a series of measurements employing two cylinders of circular cross section which can be moved in a water tank with velocities between 0·5 and 11·5 cm./sec. The wake is photographed by a continuously recording roll film apparatus and enlarged positives are made. In discussing the types of vortices recorded it is shown by Rosenhead that the double row of vortices forms with varying degrees of regularity between a lower limit and an ill-defined upper limit of the Reynolds number. The stream line patterns are very similar to those derived from the theoretical investigations. Curves show the variation of the longitudinal spacing, lateral spacing, spacing ratio, and velocity of the vortices with increasing Reynolds number, for different values of the ratio of radius of cylinder to the channel width. [See Abstracts 867 and 3623 (1930).] R. S. R.

333. Extension of the Method of Conformal Representation to Motion in Three Dimensions. Alayrac. *Comptes Rendus,* 191. *pp.* 290–292, *Aug.* 11, 1930.—The extension of the analytical method of conformal representation to three-dimensional irrotational motion is briefly discussed in general terms. J. S. G. T.

334. Vortex Theory. L. S. da Rios. *Comptes Rendus,* 191. *pp.* 399–401, *Sept.* 1, 1930.—Certain results relating to linear and tubular vortex motion already published by the author (1906–1916) are briefly summarised and amplified. J. S. G. T.

335. Vibration of Cylindrical Columns in Water under the Influence of Alternating Vortices. P. Dupin. *Comptes Rendus,* 191. *pp.* 482–484, *Sept.* 22, 1930.—The characteristic vibrations of a cylindrical column, fixed at its base and exposed to a stream of fluid, so that vortices are produced alternately to right and left of the column, as in Strouhal's experiment, are discussed. Measurement of the frequency of the alternating vorticity shows that the oscillations of the cylinder and the frequencies of the vortices fall into one or other of five classes, which are specified. J. S. G. T.

336. Diffusion of Substances Deviating from the Law of Fick. D. Krüger and H. Grunsky. *Zeits. f. phys. Chem.* 150. *Abt. A.* 2. *pp.* 115–134, *Sept.*, 1930.—A discontinuous diffusion method is described which permits the determination of how far the diffusion coefficient is dependent on the concentration. It is shown that for organosols of cellulose esters the observed anomalous results of the rate of diffusion cannot be solely explained by the assumption that the diffusion coefficient is solely dependent on the concentration. It is suggested that the affinity between the dissolved cellulose ester particles as well as with the solvent molecules may also play a part. J. K.

337. Cleavage Tests of Timber. E. G. Coker and G. P. Coleman. *Roy. Soc., Proc.* 128. *pp.* 418–431, *Aug.* 5, 1930.—Tests of the resistance of timber to cleavage are usually carried out by applying equal and opposite loads, up to fracture, along the diameters of incomplete holes bored in flat specimens cut so that the stress is normal to the direction of the grain. Such tests afford no precise data as to the stress at which cleavage occurs. The matter is critically examined and discussed by reference to photo-elastic tests carried out with isotropic material, nitro-cellulose, particular attention being paid to the effect of the geometry of the specimen upon the result. Fairly comparable results in cleavage tests can only be expected when one form is adhered to, and a numerical value of cleavage property, calculated from the load at fracture, and the assumption of stress conditions derived from isotropic models, can at best only afford an approximate value of this property. It would be better to rely on a simple tension test to define cleavage property, the load being applied uniformly and normally to the grain of the timber. [See Abstract 1754 (1929).] J. S. G. T.

338. Theory of Forced Transversal Vibrations of Homogeneous Rods of Constant Section. H. Schmidt. *Zeits. f. Physik*, 64. 5–6. *pp.* 411–424, 1930.—Shows how the methods employed by the author [see Abstract 2395 (1930)] in the study of the vibrations of cords and ropes can be applied to the above problem. H. N. A.

339. Longitudinal Elastic Frequencies of Cylinders, Using a Magnetostriction Oscillator. D. S. Muzzey, Jr. *Phys. Rev.* 36. *pp.* 935–947, *Sept.* 1, 1930.—Cylindrical rods of stainless steel were set in longitudinal vibration by using a magnetostriction oscillator [see Abstract 2500 (1928)], and their resonant frequencies were determined by comparison with a crystal oscillator. The dimensions of the rods were changed in small steps, and the longitudinal frequency was measured after each cutting. Graphs are given in which wave velocity is plotted against log (diameter/length). The relation between frequency and dimensions is very nearly that predicted by elastic theory for the "free-free" vibrations of a cylinder. G. E. A.

340. Stable Equilibrium in a Velocity Field. B. de Finetti. *Pont. Accad. Sci., N. Lincei. Atti*, 83. *pp.* 190–201, *March* 16, 1930.—Defines stable equilibrium in a zero point of a velocity field, and determines the conditions for its existence. E. E. F. d'A.

341. Resistance of Impact on Water Surface. Part II. Cone (continued). S. Watanabe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 268. *pp.* 153–168, *Sept.* 20, 1930. *In English.*—The results contained in a previous paper [see Abstract 2400 (1930)] are employed to deduce an empirical formula for the resistance of impact, R (kg. cm. sec. units) of a cone of angle θ° and mass M, meeting a water surface with velocity V and becoming immersed to a depth x. The formula takes the form $R = 6\cdot 7 \times 10^{-6}x^2V^2M \tan^2(\theta/2)/[M + 0\cdot 12x^2 \tan^3(\theta/2)] \cos(\theta/2)$. Theoretical and experimental results agree fairly well with one another and the theoretical and empirical formulæ can be made to agree by suitable adjustment of the constants. It appears that impact resistance is determined principally by the rate of change of momentum of the water displaced by the cone. J. S. G. T.

342. Crystal Structure of Krypton. W. H. Keesom and H. H. Mooy. *K. Akad. Amsterdam, Proc.* 33. 5. *pp.* 447–449, 1930. *Comm. No.* 209*b from the Phys. Lab., Leiden. Nature*, 126. *p.* 243, *Aug.* 16, 1930. —A film of krypton 0·07 mm. thick, examined at − 252·5° by Fe and CuKα radiation, gives lines indicating a face-centred cubic structure with lattice constant 5·59 Å. (save that the line 200 was not observed); density 3·13 and atomic weight 82·9. The distance between centres of adjoining atoms is 3·95 Å., compared with 3·23 Å. from viscosity measurements, giving the ratio 1·22. The corresponding ratios for neon, argon, and xenon are respectively 1·35, 1·29 and 1·23; or, using Rankine and Smith's corrected values for the atomic diameters [see Abstract 272 (1922)], the ratios are neon 1·39, argon 1·34, krypton and xenon 1·28. The unexpectedly low value for krypton is possibly due to its structure having been investigated at a relatively lower temperature than those of the other gases. C. A. S.

343. Crystal Structure of Azobenzene. M. Prasad. *Phil. Mag.* 10. *pp.* 306–313, *Aug.*, 1930.—The structure of the azobenzene crystal has been examined. The dimensions of the unit cell are $a = 12\cdot 65$ Å.;

$b = 6 \cdot 06$ Å.; $c = 15 \cdot 60$ Å.; $\beta = 114°24'$. The cell contains four molecules. A remarkable feature is the nearly complete symmetry about the $(20\bar{1})$ plane, both in respect to the geometrical relations and to the intensities of reflection by corresponding planes. AUTHOR.

344. Crystal Structure of Cementite. S. B. Hendricks. *Zeits. f. Krist.* 74. 5–6. *pp.* 534–546, *Aug.*, 1930. *In English.*—The crystal structure of cementite, derived from the X-ray diffraction data of Westgren and Phragmen [see Abstract 469 (1925)] can be considered as a non-ionic coordination structure of octahedra of iron atoms around central carbon atoms. The orthorhombic unit of structure containing $4Fe_3C$ has the dimensions $a = 4 \cdot 518$ Å., $b = 5 \cdot 069$ Å., $c = 6 \cdot 736$ Å. The space group is V_h^{16}; the atomic positions and parameter values are given. A. J. M.

345. Crystal Structure of the Carbides MeC_2. M. v. Stackelberg. *Zeits. f. phys. Chem.* 9. *Abt. B.* 6. *pp.* 437–475, *Sept.*, 1930.—X-ray measurements by the powder-method for a series of carbides of composition, MeC_2 (acetylene derivatives) indicate a tetragonal-centred lattice with four molecules in the zone element. The lattice constants are given for the carbides of calcium, strontium, barium, lanthanum, cerium, praesodymium, neodymium, thorium, $NaHC_2$ and KHC_2. From the six possible atomic arrangements, present knowledge of the relationship between chemical constitution and crystal structure indicates a tetragonal deformed common salt structure in which the anions are replaced by C_2-groups which all lie in the direction of the *c*-axis. The results are confirmed by the Weissenberg-Böhm method, and the tetragonal symmetry of the carbides of calcium, strontium and barium supported by measurements with the polarisation microscope. The crystallites have dimensions of about 10^{-2} mm. The position of the hydrogen atoms in $NaHC_2$ and KHC_2 is discussed. A new lattice type is indicated similar to the pyrites lattice, which includes a large number of substances. H. H. Ho.

346. Influence of RO_4'' and Related Ions on the Crystalline Form of Sodium Chlorate. H. E. Buckley. *Zeits. f. Krist.* 75. *pp.* 15–31, *Sept.*, 1930. *In English.*—Most substances added as " impurity " to a solution of sodium chlorate have little or no effect on its habit of crystallisation (a cube). Those, however, which contain ions of the type RO_4'', or one closely related thereto, cause it to assume a tetrahedral habit. By methods previously described [see Abstract 3017 (1930)] the relative concentrations of the " impurity " ions to that of chlorate required just to bring about disappearance of the cube have been determined as follows: SeO_4'' 3 : 1; ClO_4' 2 : 1; Cr_2O_7'' > 1 : 1; CrO_4'' 1 : 1; SO_4'' 1 : 7; S_2O_3'' 1 : 20; B_4O_7'' 1 : 60; S_2O_6'' 1 : 1000; NO_3' has a slight action, but MoO_4'', MnO_4'', MnO_4', PO_4''', AsO_4''', CO_3'', SiO_3'' and S_4O_6'' have none. With S_2O_3'' and Cr_2O_7'' no effect at all was produced by additions of not more than 1/7th and 1/2 respectively of the above proportions. Crystals grown from solutions containing S_2O_3'' or SO_4'' in concentrations 1/20th that of the ClO_3' on analysis showed inclusion of about 1 ion of " impurity " to 600 of ClO_3'. The effective ions all have structures, including an O_3 triangle, and it is suggested that their influence is due to the ion adhering to these in place of a ClO_3' ion, the difference therefrom in structure of the " impurity " ion causing disturbance of the crystal structure. C. A. S.

347. Glide-Planes in Sodium Platinocyanide, Potassium Hydrogen Carbonate and Manganous Formate. O. Mügge. *Zeits. f. Krist.* 75. *pp.* 32–40, *Sept.*, 1930.—Sodium platinocyanide, $Na_2Pt(CN)_6 . 3H_2O$, is triclinic, $a : b : c = 1{\cdot}7108 : 1 : 0{\cdot}8139$; $\alpha = 94°57'$, $\beta = 92°17'$, $\gamma = 89°13{\cdot}5'$, results in close agreement with those of Baumhauer. The crystals show twins on [110] and [001], the latter by repetition give rise to lamellæ, which can be produced artificially by shear parallel to [001]. Lamellæ parallel to [110] are rare, but can also be produced. Both twin planes are thus glide-planes. In both potassium hydrogen carbonate, $KHCO_3$, and manganous formate, $Mn(HCO_2)_2 . 2H_2O$, (001), is a glide-plane, though the corresponding twinning does not occur naturally. Results of optical examination are given. C. A. S.

348. X-Ray Investigation of the Cubic Forms of Perchlorates. K. Herrmann and W. Ilge. *Zeits. f. Krist.* 75. *pp.* 41–66, *Sept.*, 1930. *In German.*—Weissenberg's theory of crystal structure demands a certain degree of correspondence between crystallographic symmetry and chemical equivalence of the atoms in the lattice, and in particular in such a group as BX_4. The postulate holds for the cubic and tetragonal classes, but as the symmetry decreases the crystallographic equality is lost. Experiments are described dealing with the structure of perchlorates. The space-group is T_d^2 or T^2, with an ionic lattice of the rocksalt type. In NH_4ClO_4 and $NaClO_4$, the ClO_4 group forms a close-packed tetrahedron with Cl at the centre. The transition from the cubic to the rhombic form is discussed. F. I. G. R.

349. Corrosion and Regeneration of Porphyritic Quartz. G. Laemmlein. *Zeits. f. Krist.* 75. *pp.* 109–127, *Sept.*, 1930. *In German.*—Magmatic fusion is found not to corrode the faces; in fact, they become polished, while the angles and edges are bevelled away, giving rise to rounded forms. Deformed crystals of quartz in quartz-porphyry are regenerated in the magma. The remainder of the paper deals with more purely petrographic details. F. I. G. R.

350. Parachors of Two Isomeric Chlorodinitrobenzenes. D. V. Sickman and A. W. C. Menzies. *Am. Chem. Soc., J.* 52. *pp.* 3327–3329, *Aug.*, 1930.—The experimental data found in the literature for the isomerides 1-chloro-2 : 4- and 1-chloro-3 : 4-dinitrobenzene, yield values of the parachor which are very widely convergent, instead of the expected identity. By redetermination of densities and surface tensions, this discrepancy is shown to be due to experimental error, and whilst the values of the two corrected parachors are shown to be very concordant, there is still a difference, which requires explanation, of 3·2 % from the parachor as calculated from Sugden's adopted constants. H. H. Ho.

351. Complexity of Nitrogen. A. Smits, H. Gerding and W. Hertogh. *Phys. Zeits.* 31. *pp.* 768–769, *Aug.* 15, 1930.—Experimental investigation does not confirm the observation of Justi [*Naturwissenschaften*, 18. 227 (1930)] that nitrogen which has been heated to a certain temperature immediately after fusion exerts a different vapour pressure at this temperature from liquid nitrogen which has not first been solidified. The results given by Justi are attributed to the use of insufficiently purified nitrogen. A. J. M.

352. Theory of Brownian Motion. G. E. Uhlenbeck and L. S. Ornstein. *Phys. Rev.* 36. *pp.* 823–840, *Sept.* 1, 1930.—With a method first indicated by Ornstein the mean values of *all* the powers of the velocity u and the displacement s of a free particle in Brownian motion are calculated. It is shown that $u - u_0\exp(-\beta t)$ and $s - u_0/\beta[1 - \exp(-\beta t)]$, where u_0 is the initial velocity and β the friction coefficient divided by the mass of the particle, follow the normal Gaussian distribution law. For s this gives the exact frequency distribution corresponding to the exact formula for $\overline{s^2}$ of Ornstein and Fürth. Discussion is given of the connection with the Fokker-Planck partial differential equation. By the same method exact expressions are obtained for the square of the deviation of a harmonically bound particle in Brownian motion as a function of the time and the initial deviation. Here the periodic, aperiodic and overdamped cases have to be treated separately. In the last case, when β is much larger than the frequency and for values of $t \gg \beta^{-1}$, the formula takes the form of that previously given by Smoluchowski. AUTHORS.

353. Reflection of Cadmium and Zinc Atoms from Sodium Chloride Crystals. H. A. Zahl. *Phys. Rev.* 36. *pp.* 893–903, *Sept.* 1, 1930.—A beam of zinc atoms reflected from a sodium chloride crystal is in part specularly reflected. The specular beam was investigated: (1) by measuring the velocity distribution of the atoms composing the specular beam; and (2) by examining the specular beam after reflection from a second crystal. A difference in angle of 22·5 between the two crystals does not greatly reduce the intensity of the specular beam. It is concluded that if velocity selection or a space-grating type of reflection of zinc is present it is not very pronounced. Double reflection experiments of cadmium from sodium chloride crystals have been repeated and apparently evidence for both space and surface-grating phenomena found in certain cases. It is suggested that individual differences in crystals may be an important factor in causing these differences. AUTHOR.

354. Separation of Isotopes. K. P. Jakowlew. *Zeits. f. Physik*, 64. 5–6. *pp.* 378–391, 1930.—Describes an apparatus which makes it possible to collect small quantities of individual isotopes, by separating a beam of positively charged particles into its components using an electrostatic and a magnetic field, and allowing these components to pass into small funnels, and so through capillary tubes into exhausted glass bulbs. In this way it has proved possible to collect a few tenths of 1 c.mm. of the isotopes Ne^{20} and Ne^{22}. These have been examined in Geissler tubes, but no difference between their spectra could be observed with apparatus giving an accuracy of 0·006 Å. The theoretical difference in wave-length to be expected in the visible spectrum is, however, only 0·0005 Å. It is proposed to analyse the separated isotopes by means of the positive ray method. H. N. A.

355. Theory of Molecular Forces in Dipole Gases. H. Margenau. *Zeits. f. Physik*, 64. 9–10. *pp.* 584–597, 1930.—A mathematical paper in which a comparison is made between the classical expression for the second virial-coefficient [see Abstract 35 (1931)] and an expression for the same quantity derived from quantum mechanics by R. H. Fowler (*Statistical Mechanics*, p. 172). This expression for sufficiently high temperatures agrees with the classical one. The deviation at lower temperatures is approximately calculated. T. B.

356. Lattice Constants of the Elements. W. Hume-Rothery. *Phil. Mag.* 10. *pp.* 217–244, *Aug.*, 1930.—From the existing values for the lattice constants of the elements it is shown that in any one sub-group of the periodic system, provided that the coordination number remains constant, the interatomic distance d is given by the relation $d/n = (aZ)^{-x}$, where n is the principal quantum number of the outermost shell of electrons remaining attached to the ions; Z is the atomic number; x is a constant which is the same for groups with the same number of electrons in the outermost shell of the atomic core or ion; a is a second constant which in some groups may be connected with the valency. The available evidence shows that change in the coordination number does not cause the same percentage contraction in the different groups: in Group IV the effect of coordination changes is comparatively slight. It is shown, further, that the interatomic distance varies inversely as Z in the first period, as Z^2 in the second and as Z^3 in the third. In the fourth period the interatomic distance varies inversely not as Z^4 but approximately as Z^5. The theoretical implications of these results are discussed. F. J. W.

357. Simple Foundation for the Classification of Elements. H. Heribert. *Zeits. f. Elektrochem.* 36. *pp.* 687–688, *Sept.*, 1930. *Paper read before the Deut. Bunsen. Gesell., Heidelberg, May–June*, 1930.—In this paper a classification of the periodic system is given in the form of a dynamic model which expresses the data in place of the usual tabular static presentation. The simple considerations employed are that the atomic numbers of the elements which occur in the same group of the periodic system are separated from each other by three intervals, *viz.*, by 2×2^2, 2×3^2, 2×4^2, and these relationships may be geometrically interpreted by a model which is described in detail with illustrations. H. H. Ho.

358. Principle of Causality in the Phenomena of Microstructure. G. Gianfranceschi. *Pont. Accad. Sci., N. Lincei, Atti.* 83. *pp.* 94–98, *Jan.* 19, 1930.—The author brings forward arguments to show that the principle of causality—which can be expressed as physical determinism and constitutes the fundamental postulate of all physics—is not invalidated by the results hitherto attained in the study of the phenomena of microstructure by the uncertainties as much of fact as of method that exist in this field. The uncertainty of fact consists in the incapacity in which we find ourselves of knowing completely the system of bodies and of forces studied, the incapacity of assigning completely the initial conditions both of the acting system and of that suffering the action. The uncertainty of method consists in that the processes of the theory made use of give only approximate results or at most statistical results. But this quality of indeterminateness that exists in our theoretical methods is due to the indeterminateness that exists in the measurements of the magnitudes that are dealt with in the phenomena studied. J. J. S.

359. Wave Statistics. K. C. Kar. *Zeits. f. Physik*, 64. 1–2. *pp.* 75–80, 1930.—The generalised statistical theory of wave mechanics developed by Kar and Mukherjee in a previous paper [see Abstract 3044 (1930)] is here extended to show that the de Broglie hypothesis of phase waves is redundant so far as the deduction of the quantum condition for a Bohr orbit is concerned. J. S. G. T.

360. New Form of the Quasi-Electromagnetic Equations of Wave Mechanics. W. Alexandrow. *Zeits. f. Physik*, 64. 1–2. *pp.* 135–146, 1930.—The new form of the quasi-electromagnetic or Dirac wave equations is derived by analogy with the electrodynamic equations of the Weyl-Eddington theory which include a cosmological term proportional to $\frac{1}{R^2}$, where R is a length of cosmological magnitude (world radius). In the material wave equations the place of R is taken by the Compton wave-length $= h/m_0c$, where m_0 is the electron mass. The " rest mass " of the light quant m_{00} is related to R by the formula $R = h/m_{00}c$. The present system is claimed to show a closer parallelism between wave mechanics and light theory. W. S. S.

361. Solution of Dirac's Equations without Specialisation of the Dirac Operators. Part II. F. Sauter. *Zeits. f. Physik*, 64. 5–6. *pp.* 295–303, 1930.—Continuing previous work [see Abstract 49 (1931)], in which the eigenvalues and eigenfunctions of the Dirac wave equation were obtained without specifying the operators γ_ν beyond subjecting them to the condition $\gamma_\mu\gamma_\nu + \gamma_\nu\gamma_\mu = 0$ for $\mu \neq \nu$, $= 2$ for $\mu = \gamma$, the author now considers the interpretation of magnitudes quadratic in ψ, such as $\bar{\psi}\gamma_\nu\psi$. It is found that for such expressions to have a definite physical meaning an additional condition must be satisfied which corresponds to the choice of a suitable integration constant in the solution of the general wave equation. With this new condition it appears that Dirac's original method treating the operators γ_μ as four row matrices gives in effect the most general solution. The question is discussed whether it is desirable to work with the unspecified operators and apply the restricting condition at the end, or whether it is better to assume from the start the γ_μ's to be four row matrices. W. S. S.

362. Fundamental Integrals of a Wave-Mechanics Differential Equation. C. W. Oseen. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 22. *A*. 2 [25 *pp*.], 1930. *In German*.—The fundamental solutions of the partial differential equation $\frac{\partial^2\psi}{\partial x^2} - \frac{8\pi^2 m}{h^2}\left(A + Bx^2 + \frac{C}{x^2}\right)\psi = \frac{4\pi i m}{h}\frac{\partial\psi}{\partial t}$ are obtained, this equation representing the one-dimensional motion of a mass in a potential field $A + Bx^2 + \frac{C}{x^2}$ according to Schrödinger's non-relativistic wave mechanics. The general solution is applied to trace the subsequent behaviour of a wave packet defined at $t = 0$, and also to obtain the probability of an electron penetrating a potential barrier. The determinations of the eigenvalues and eigenfunctions are summarised as follows:

Eigenvalues E

$$\text{B positive}\begin{cases} C > 0 & (\mu + 1)\frac{h\nu}{2\pi},\quad (\mu + 3)\frac{h\nu}{2\pi}\ \dots \\ \frac{-h^2}{32\pi^2 m} < C < 0 & \begin{cases} (\mu + 1)\frac{h\nu}{2\pi}, & (\mu + 3)\frac{h\nu}{2\pi}\ \dots \\ (-\mu + 1)\frac{h\nu}{2\pi}, & (-\mu + 3)\frac{h\nu}{2\pi}\ \dots \end{cases} \\ C < -\frac{h^2}{32\pi^2 m} & \text{None} \end{cases}$$

$$\text{B negative}\quad \begin{cases} \textit{Continuous spectrum} \\ -\infty < E < +\infty \end{cases}$$

Here $\mu = \left(\frac{1}{4} + \frac{8\pi^2 mC}{h^2}\right)^{\frac{1}{2}}$ and $\nu = \sqrt{\frac{2B}{m}}$. The fundamental integral, eigenvalues and eigenfunctions of the analogous three-dimensional problem $\nabla^2\psi - \frac{8\pi^2 m}{h^2}\Big(A + \sum_{k=1}^{3} B_k x_k^2 + \sum_{k=1}^{3} \frac{C_k}{x_k^2}\Big)\psi = \frac{4\pi m i}{h}\frac{\partial\psi}{\partial t}$ are also obtainable directly by the author's method and the special case $C_1 = C_2 = C_3 = 0$ is discussed. W. S. S.

363. Causality in Quantum Mechanics. G. W. Kellner. *Zeits. f. Physik,* 64. 1–2. *pp.* 147–150, 1930.—Considers two objections, which have been raised against the treatment of the Heisenberg γ-ray microscope in the author's paper [see Abstract 2436 (1930)]. Shows that these objections are unjustified, and that the author's treatment follows the same lines as Schrödinger's treatment of the Compton effect. H. N. A.

364. Causality in Physics. G. W. Kellner. *Zeits. f. Physik,* 64. 7–8. *pp.* 568–580, 1930.—Shows that the apparent discrepancy between the quantum theory and the causality axiom depends on the fact that the axiom is understood differently by different authors. Kant considers that his statement of the axiom defines what is necessary in order that thought can be carried on. It can in no way be looked upon as a " law of nature." Taken in this sense the axiom is in agreement with the quantum theory. H. N. A.

365. Causality in Behaviour of Electrons. J. Stark. *Ann. d. Physik,* 6. 6. *pp.* 681–699, *Sept.* 25, 1930.—This is a critique of the theory put forward by Sommerfeld in opposition to that proposed by the author [see Abstract 2835 (1930)]. Among the topics dealt with are the stationary states of electrons in the atom, elementary light emission and the structure of electrons. F. S.

366. Theory and Calculation of Screening Constants. C. Eckart. *Phys. Rev.* 36. *pp.* 878–892, *Sept.* 1, 1930.—It is shown that if H is the negative energy operator, and ϕ any function satisfying the boundary conditions of quantum dynamics and possessing the symmetry properties characteristic of a given spectral series, then $E = \int\phi^* H\phi d\tau$ is a lower limit to the term-value of the lowest level of that series. If the integral is evaluated for various ϕ's, the largest value obtained will be the best approximation to this term value. The method is applied to various electronic configurations with satisfactory results. The degree to which ϕ approximates the wave function of the state is not determined, but it is shown to be likely that the approximation is not good at large distances from the nucleus. AUTHOR.

367. Quantum Transitions in Collisions of the Second Kind. H. Beutler and W. Eisenschimmel. *Zeits. f. Elektrochem.* 36. *pp.* 746–747, *Sept.,* 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June,* 1930.—Wigner's group-theory discussion of the quantum transitions occurring when two atoms or molecules interact in a collision of the second kind shows that the term multiplicity of the two particles, considered as one system, tends to be maintained. For example, if an excited krypton atom in the triplet 2^3P_2 state collides with a mercury atom in the normal singlet state 1^1S_0, the mercury atom after collision is more likely to be in a 5^3D_n state than in a 5^1D_2 state, these states being in equally good " resonance " with the excited krypton atom. Experimental test of this case under theoretical conditions is impossible, but the variation in intensity of mercury lines can be determined when small quantities of krypton gas are introduced into the discharge tube. The measurements show definitely that for small pressures of the krypton, the triplet terms are excited to a much greater degree than the singlet terms of practically the same "resonance" potential. The physical interpretation of the effect is that in addition to the energy resonance of the colliding particles, resonance of electron interchange plays a part. Application of the same idea to collisions of molecules is also discussed briefly. W. S. S.

368. Equations of Motion of the Electron. U. Kakinuma. *Phys. Math. Soc., Japan, Proc.* 12. *pp.* 159–166, *Sept.*, 1930. *In English.*—The author's metrical wave theory of electron structure [see Abstract 3345 (1930)] is discovered to contain a serious contradiction. The present paper deals with the removal of this blemish. The modifications necessary leave intact the relations previously obtained between Planck's constant, *h*, and constants of the electron. W. S. S.

369. Possibility of Avoiding an Infinite Auto-Reaction for the Electron. V. Ambarzumian and D. Iwanenko. *Zeits. f. Physik*, 64. 7–8. *pp.* 563–567, 1930.—A difficulty has been found to arise in quantum electrodynamics from the fact that the value of the auto-reaction of an electron is found to be infinite. In order to surmount this difficulty the authors make use of difference equations instead of differential equations. They suggest the use of a cubic point lattice in three-dimensional space, with lattice constant *a*, electrons are only found at lattice points, and all the equations of atom mechanics are to be written as difference equations. Works out an expression for the auto-reaction on this basis. H. N. A.

370. Exclusion Principle and Intra-Molecular Statistics. L. Goldstein. *Comptes Rendus*, 191. *pp.* 521–522, *Sept.* 29, 1930.—Amplifying a previous note [see Abstract 3650 (1930)] the author points out the limitations of the method for obtaining the distribution of the electrons in a molecule by Fermi's statistical method. W. S. S.

371. Resonance Methods for Determining G. J. Kunz. *Phys. Zeits.* 31. *pp.* 764–768, *Aug.* 15, 1930.—Two dispositions of apparatus for determining the gravitation constant G are suggested, and the necessary mathematical theory worked out. J. H. A.

372. Absorption of Gravitation by Matter. Q. Majorana. *J. de Physique et le Radium*, 1. *pp.* 314–324, *Sept.*, 1930.—The author has made a number of experiments during the past ten years to find out if there is any evidence of a screening effect of matter on the action of gravitation. A lead ball was weighed by means of a very sensitive balance, and was then surrounded by a mass of mercury, or of lead, arranged symmetrically with respect to the centre of the sphere, so that its own gravitational action on the latter was zero. The lead ball was weighed again in this position, and minute diminutions in the weight were observed, which are tentatively ascribed to an absorption of "gravitation" in the heavy mass surrounding the ball. Some remarks are made on the astromonical aspects of the problem, the relation to the theory of relativity, and the evidence to be deduced from the tides. The research is being continued. H. N. A.

373. Ether Concept in Modern Physics. L. B. Spinney. *Science*, 72. *pp.* 303–310, *Sept.* 26, 1930.—A non-technical sketch of the history of the theories of the ether which have prevailed in the last 150 years. G. C. McV.

374. Pressure on Electron. T. Takéuchi. *Phys. Math. Soc. Japan, Proc.* 12. *p.* 220, *Sept.*, 1930. *In French.*—The pressure on a charged sphere radius a, charge e, was shown by Poincaré to be $p = \frac{e^2}{8\pi a^4}$. The author shows that this can be related to the Gaussian curvature of the space-time in which the sphere occurs. G. C. McV.

375. Theory of Teleparallelism. A. Einstein. *Preuss. Akad. Wiss. Berlin, Ber.* 21–23. *pp.* 401–402, 1930.—It is shown that any antisymmetric terror, in the theory of parallelism at a distance, has the property that its divergence with respect to either antisymmetric index is identically zero. G. C. McV.

376. Diminution of the Velocity of Light. V. S. Vrkljan. *Zeits. f. Physik,* 63. 9–10. *pp.* 688–691, 1930.—A diminution of the velocity of light of 4 km./sec. in the last fifty years can be deduced from the comparison of various determinations of this velocity. General relativity can give an interpretation of this, if we suppose that the $g_{\mu\nu}$ of the line-element of the space in which the earth moves are functions of the time. G. C. McV.

377. General Solution of Einstein's Equations. W. R. Andress. *Roy. Soc., Proc.* 128. *pp.* 523–530, *Aug.* 5, 1930.—A solution of the equations $G_{\mu\nu} = 0$ when the line-element is orthogonal and the $g_{\mu\nu}$ involve three of the four space-time variables explicitly. The method of solution is by successive approximations. Physically this means that the line-element eventually found is that corresponding to a space which, being originally empty, has been altered by the introduction of a certain distribution of matter. The first approximation in the solution of the equations gives an arbitrary function of integration $\sigma(xyz)$, which is found to be the density of the matter in the space, to a first approximation. The $g_{\mu\nu}$ are then found as series of successive orders in $\sigma(xyz)$. It is also shown how it comes about that solutions of this kind are possible. G. C. McV.

378. Experimental Proof of General Relativity. G. v. Gleich. *Zeits. f. Physik,* 64. 9–10. *pp.* 717–726, 1930.—The author claims to show that the displacement of the perihelion of Mercury is an illusion due to a slowing down in the earth's orbital velocity. G. C. McV.

379. Projective Relativity. O. Veblen and B. Hoffmann. *Phys. Rev.* 36. *pp.* 810–822, *Sept.* 1, 1930.—In this paper it is shown that the formalism of O. Klein's version of the five-dimensional relativity [see Abstract 845 (1928)] can be interpreted as a four-dimensional theory based on projective instead of affine geometry. The most natural field equations for the empty space-time case are a combination into a single invariant set of the gravitational and electromagnetic field equations of the classical relativity *without modification.* This seems to be the simplest possible solution of the unification problem. When a restriction on the fundamental projective tensor which was imposed in order to reduce the theory to that of Klein is dropped, a new set of field equations is obtained which includes a wave equation of the type already studied by various authors. The use of projective tensors and projective geometry in relativity theory seems, therefore, to make it possible to bring wave mechanics into the relativity scheme. AUTHORS.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

380. Annual Variation of Ozone in the Upper Atmosphere. S. Chapman. *Phil. Mag.* 10. *pp.* 345–352, *Aug.*, 1930.—The possibility of thermal decomposition being the main process in the decay of O_3 is examined. Annual mean values and ranges of T and k, the recombination coefficient, can be assigned to account for the observed annual variation of O_3 and its distribution in latitude assuming the rate of production is constant. The maximum of T and k must then occur one month after the summer solstice, and the interval between the maxima of O_3 and T is about four months. If the temperature at 45 km. is partly determined by large-scale convection, a lag of maximum temperature after the solstice is possible. In an earlier paper [see Abstract 3658 (1930)] it is assumed that if the temperature of the O_3 layer at 45 km. were sufficiently below 400° K., thermal decomposition was negligible. With a lower limit of 385° K. this hypothesis can fit the annual variation. Existing observations relating to temperatures at this height are discussed. R. S. R.

381. Ozone and Atomic Oxygen in the Upper Atmosphere. S. Chapman. *Phil. Mag.* 10. *pp.* 369–383, *Sept.*, 1930.—The author considers the various processes by which ozone may result from oxygen atoms and molecules and the reverse processes by which atomic oxygen may result. Numerical relations are next taken and the changes in the amounts of O_3 and O at different heights and times of day or night considered. It is concluded that ultra-violet radiation is, at least in part, the mechanism transforming oxygen molecules into atomic oxygen, being gradually absorbed in the highest atmospheric strata and there dissociating the oxygen. At sufficiently great heights recombination will be slow, little O_3 will be formed and O will accumulate and rise by diffusion to become, with atomic nitrogen, in the absence of H and He, the chief atmospheric constituent. At lower levels oxygen atoms attach themselves to oxygen molecules to form O_3. Thus it is likely that (1) ozone concentration diminishes rapidly with height above the level of maximum concentration, and especially above the level where convective mixing is important, and (2) atomic oxygen concentration increases upwards until it exceeds that of molecular oxygen. R. S. R.

382. Zonal Distribution of Rainfall over the Earth. C. E. P. Brooks and Theresa M. Hunt. *Roy. Meteorolog. Soc., Mem.* 3. *No.* 28. *pp.* 139–158, *Sept.*, 1930.—In preparing the zonal distribution of annual rainfall, the charts for some countries were considered separately and in others combined to give a chart for the whole continent. For the Antarctic data were almost entirely lacking. In tables are shown for 5° zones of latitude, for (1) land and (2) sea, values of (i) average annual rainfall, (ii) area in zone, and (iii) total volume of water precipitated in the area, and these are next combined to give the average rainfall for the whole globe in zones of 5° of latitude. These tables show average rainfall for (1) land, 659 mm.; (2) sea, 1107 mm.; and (3) the whole globe, 975 mm. For land the maximum of 2000 mm. lies just south of the Equator, and a secondary maximum at 50° – 60° S. In the Northern Hemisphere there is an almost continuous decrease polewards. Over the sea the maximum lies over the storm belt at 50° N. The values are compared with older estimates of Murray, Bezdek, Fritsche and Kerner and show wide discrepancies in polar and equatorial zones, but sufficiently good agreement in temperate zones. Values are next calculated for monthly values and tabulated in 5° zones for (1) land, (2) sea, and (3) the whole globe; while isopleths show the variations over land and sea. Finally, the average annual value is calculated for the continents, and in an appendix the mean rainfall is given for individual countries of Europe and Asia and some groups of islands. R. S. R.

383. Coaggregation of Clouds and Fog. E. Frankenberger. *Phys. Zeits.* 31. *pp.* 835–840, *Sept.* 15, 1930.—The influence of a small homogeneous electric drop charge on the rate of coaggregation is first considered. For different ratios of drop charge to limiting charge the corresponding ratios for the rates of coaggregation in the charged and uncharged cloud are found. Where the first ratio is small, the charged and uncharged clouds give nearly the same amount of rain per second. Coaggregation is important for the disappearance of clouds, but for drops of equal size, although considerable precipitation may result, clouds will not disappear in a few hours. For a given vertical ascent of the air the stationary state is possible only for a definite water content, and the time required to reach this state decreases as the rate of ascent increases. The precipitation responds slowly to changes in the vertical velocity and the rate of ascent can then be calculated more certainly for warm than for cold fronts. With the latter large oscillations in the vertical velocity occur with different cloud forms and showers. [See Abstract 2749 (1930).] R. S. R.

384. Small Ion Content of the Atmosphere at Heligoland. O. Mathias. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 360–377, 1930.—From a statistical examination of the number of small ions in the air at Heligoland some remarkable relations with meteorological and maritime factors are obtained. This is especially so for those factors which are connected with the number of nuclei, *e.g.*, direction of wind, transparency of the atmosphere and sunshine. In the counting of ions the Aitken nuclei are found to be of the utmost importance with reference to the number of small ions, and it is recommended that both the small ions and the nuclei be counted simultaneously. No direct influence of temperature could be obtained, but correlations of the small ion content with the tides and the cloudiness of the sky are shown. The number of ions increases with increasing clouds whilst the average number of small ions is considerably greater at high tide than at low, due apparently to a local formation of nuclei. The relative humidity as well as the number of nuclei show correlations with the ratio of the number of small positive ions to the number of small negative ions, due to different capacities for the collection of small ions around small drops. The relation of the same ratio to the height of the waves is rather complicated and requires further investigation. Hess's results regarding the ionisation balance do not agree with the present results when corrected after recalibration of the anemometer, and the relation between the number and average life of small ions deviates from the linear law for high values of the small ion content. R. C. F.

385. Distribution of Atmospheric Polarisation. A. Sinjagin. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 382–425, 1930.—Mathematically examines the distribution of atmospheric polarisation and continues a previous contribution on the same subject [see Abstract 1765 (1930)]. From the primary formula for the "current lines" of polarisation, which are generalised for any position of the sun, a general and extremely accurate formula is developed for the angle formed by the plane of polarisation of a certain point and its vertical, using the spherical coordinates of the point. When the sun's height is zero a much more simple expression than the one previously given is obtained. The preliminary chart of isoclines is corrected as are those given previously by other authors, and it is shown that the curve given by Busch is not a lemniscate as was originally accepted. Finally, the general equations of the "current lines" of the plane of atmospheric polarisation, and of the family of isoclines for the angle of this polarisation, are deduced. The original of this paper should be consulted. R. C. F.

386. Degree of Polarisation of the Light from the Sky. W. Smosarski. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 426–436, 1930.—From measurements of the polarisation of the light from the sky, in the direction of the zenith, at sunrise and sunset, it is found that the neutral point of Arago is lower when the polarisation is great than when the polarisation is weak. Similar variations of the neutral point are obtained before sunset, but for twilight inverse variations, which are very pronounced, are found. R. C. F.

387. Gravity Gradient and Curvature. Edith A. Nelson. *Phil. Mag.* 10. *pp.* 513–516, *Sept.*, 1930.—A survey with the Eötvös balance shows that in certain instances the curvature of the level surface changes sign when the gravity gradient is a maximum, while in the other cases this does not hold. Investigation shows that there is no general relation between the quantities, and that this phenomenon is evidence of stratification in that region of the earth's crust, the edge of the stratum being situated below the point of the maximum gradient. W. A. R.

388. Shock Dispersion. K. Sezawa and G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 8. *pp.* 321–337, *Sept.*, 1930. *In English.*—The part of transmitted waves dispersed by an echoing medium is not of regular form, while in ordinary dispersed waves the oscillatory part is quite regular and has gradually varying wave-length. In echoed dispersion the leading part is distinct and has large amplitude. In ordinary dispersion both leading and trailing parts have their own velocities of propagation. A portion of the vibrations of echoing dispersion is of a gradually decaying type, whilst in ordinary dispersion this is not in general possible. [See Abstract 853 (1928).] W. A. R.

389. Comparison of Records of Two Galitzin Pendulums. H. Landsberg. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 326–359, 1930.—Systematically investigates the records of two Galitzin pendulums which are registering the same components of earthquakes and yet have different periods of 3 and 18 sec. The short-period pendulum gave good registrations of the beginnings of earthquakes, as well as accurately showing the commencement of secondary earthquakes. The later stages of the earthquakes were well recorded by the long-period pendulum. The results of 94 earthquakes show that the short waves always arrive first, whilst in more than 50 % of the earthquakes examined no long waves at all appeared in the P phase. Generally, there is a time-interval between the appearance of the maximum of short-period and long-period waves, whilst the possibilities of a time difference of 0·5 to 2 sec. in the P phase of both types of waves is discussed. The focus distance is found to affect the proportion of the maximum amplitudes of both types of waves in this phase. Further groups of waves which are not well defined appear between the P and S phases, which are used for the construction of time curves. Waves which have been longitudinal throughout the whole journey are shown to have short periods in all phases. The question of short periods at changing waves is discussed and the proportion of the different phases in the two pendulums is given. Only 4 to 10 sec. microseisms are investigated, owing to the pendulum limitations. The short and long periods record as well in summer as in winter, but the amplitudes belonging to different phases change with the seasons. Finally, the effects of the sea breaking on the English and Norwegian shores are investigated and the same changes are found, both in the microseisms and the breaking of the waves. R. C. F.

390. Effect of Asymmetry on Solar Motion. M. Kaburaki. *Phys. Math. Soc., Japan, Proc.* 12. *pp.* 213–219, *Sept.,* 1930. *In English.*—Experimental data are given in support of the relation $V = V_0e^{p'v}$, V = solar velocity derived from a group of stars of space-velocity v, V_0 = actual solar velocity, p' = constant. The values of V for giant stars are less than those for dwarfs. This result is interpreted as being due to an effect of asymmetry in stellar motions occurring in the galactic plane, in a direction almost perpendicular to that of the galactic centre. G. C. McV.

391. Orbit of Pluto. T. Banachiewicz. *Comptes Rendus,* 191. *pp.* 246–248, *Aug.* 4, 1930.—The determinations of Pluto's orbit, which are based on the most widely-separated observations of 1930, are those of Flagstaff and of Paris, and both of these indicate a very eccentric ellipse and a motion of recession from the earth. But the positions of 1919–1927 indicate an asteroidal eccentricity and a motion of approach. If a different method of calculation is used, the observations of 1930 are found to confirm the earlier observations, and we conclude that the orbit undoubtedly resembles that of an asteroid and that the planet is approaching us. M. A. E.

392. Trans-Neptunian Planet Pluto. B. Jekhowsky. *Comptes Rendus,* 191. *pp.* 248–249, *Aug.* 4, 1930.—The orbit of this planet has been calculated by the Lagrange-Andoyer method from four observations, *viz.,* those of 1930, Jan. 23rd, Feb. 21st, Mar. 21st, May 17th, and the result is compared with those obtained by Miller and by Stoyko. It appears that the elements agree well and are reliable, except the eccentricity and the major axis, which are too great. In a preceding note [see Abstract 3368 (1930)] it was remarked that if the intervals between the observations could be increased, the orbit would approach that determined at first by the author; and the calculations of Bower and Whipple, also those of Nicholson and Mayale, justify this conclusion. But if this is correct, Pluto is the trans-Neptunian planet sought by Lowell, or at least the first of several, as predicted by Lau. M. A. E.

393. Singular Cases in the Calculation of Orbits. L. Picart. *Comptes Rendus,* 191. *pp.* 466–468, *Sept.* 22, 1930.—In determinations of the distance of a planet from the earth's centre, the equation $\rho\Delta = D$ is employed and Δ is a factor whose form is determined from the cosines of the observed directions. In practice many observations eliminate the case where $\Delta = 0$ and avoid small values of Δ. Three cases are considered when Δ is zero, (1) three observations in directions parallel to the same plan and all distinct and a solution is given; (2) two directions confused, but the third different and a partial solution is supplied; and (3) three directions confused, and here the apparent trajectory can only present the triple point in the wholly exceptional case where it reduces to a point.

R. S. R.

394. Precessions of an Elliptical Orbit. D. D. Kosambi. *Indian Journ. Phys.* 5. *pp.* 359–364, *Sept.* 15, 1930.—The equations of motion of an infinite cylinder in an incompressible fluid, $(M + M')\ddot{\xi} + k\rho\dot{\eta} = X$ and $(M + M')\ddot{\eta} - k\rho\dot{\xi} = Y$ where ξ and η are the coordinates of the axis, M and M′ the mass of the cylinder and displaced fluid respectively, X, Y, the components of external force all per unit length, are such that the total energy of the motion is the same as when there is no circulation $(k = 0)$. Applied to the case of a string vibrating in air, the equations yield a motion of a point of the string in a precessing elliptic orbit. The precessing elliptic orbits of the planets (*e.g.*, Venus) may be explicable on the same lines assuming a circulation due to the relative rotation of the planet and its atmosphere. A possible application of the analysis to the Raman effect is also discussed in general terms. W. S. S.

395. Maxwellian Distribution of Cosmic Dust. T. Levi-Civita. *Pont. Accad. Sci., N. Lincei, Atti,* 83. *pp.* 176–189, *March* 16, 1930.—Cosmic dust includes particles of all sizes, even meteorites, supposed to be distributed in space in the Maxwellian manner. Shows that the result of an encounter with a planet is always directly opposed to the planet's motion. E. E. F. d'A.

396. Question of Origin of Meteorites. F. Paneth. *Zeits. f. Elektrochem.* 36. *pp.* 727–732, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June,* 1930.—The question is whether meteorites belong to the solar system or are " messengers from the fixed stars"; the identity of material and its similar relative abundance in the earth, the stars and meteorites do not decide this. The accepted age for the sun's planetary system is about $3 \cdot 10^9$ years, but the age of the sun itself and of the fixed stars is of a much higher order—10^{12} to 10^{13} years. The author attacks the question by the " helium method " and gives a table of 27 meteorites, their helium content per gm. in 10^{-6} cm.^{3}; their radium per gm. in 10^{-14} gm., and their age in millions of years; these are arranged in order of increasing helium content, and the last four specimens are of ages 2600, 2800, 2900, 2600 millions of years—that is, they are of planetary age, of the age of the earth. By a diagram he shows the loss of helium in iron meteors through heating. He concludes that meteorites consist of the same elements as the sun, they are genetically united to the planets, and the oldest seem to have come into being at about the same time as the earth. A. S. D. M.

397. The Polytropic Equation. F. Tyler. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 111–114, *July,* 1930.—The equation for a polytropic gas sphere is solved by a method somewhat simpler than that of Emden.

G. C. McV.

398. Radiative Equilibrium of a Planetary Nebula. E. A. Milne. *Zeits f. Astrophysik,* 1. 2. *pp.* 98–114, 1930.—A discussion of a model of a planetary nebula in which the central star is supposed surrounded by a shell of material with an absorption coefficient independent of the wave-length of the radiation passing through it—the radius of the star being supposed to be small compared with the inner radius of the shell. The radiation flux through the shell is constant and is made up partly of a beam from the central star and partly of diffuse radiation reflected from the inner face of the spherical shell. It is shown that the problem can be reduced (by means of an appropriate boundary condition) to the radiative equilibrium of a plane slab exposed to both parallel and diffuse radiation on one face. An integral equation is obtained for the intensity of radiation and solved by the use of various approximations. From this arise four different theoretical methods of determining the optical thickness of the nebula by observation. The opinion is expressed that only when two or more of these methods give the same result can confidence be placed in the determination. G. C. McV.

399. Temperature and Time of Formation of a Star. A. Véronnet. *Bull. Astronomique,* 6. 4. *pp.* 155–171, 1930.—The formation of a star in a medium by the addition of successive layers of the material of the medium to the surface of the star is studied. In the process of formation, equilibrium is established between the heat radiated from the star and the heat obtained by the fall of each successive layer on to the star's surface. A relation between the speed of formation and the temperature of each layer is deduced. If the temperature and density throughout the star are uniform, it is shown that the time of formation of the star is proportional to its mass and the density is inversely proportional to the fourth power of the temperature. The time of formation of the sun is put at 25 to 31 million years, provided the temperature throughout the sun is equal to the present surface temperature. If the temperature is taken to be three times the surface temperature the time of formation is reduced to 400,000 years. The speed of formation also decreases with the increase of the radius. If the hypothesis of constant speed of formation is adopted, the mean temperature of the star must be less than the surface temperature. The general conclusion is that stars of the type of the sun must have had temperatures and radii little larger than at present at the time when they were formed. Perfect gas stars lead to longer times of formation and mean temperatures very much higher than the surface temperatures. G. C. McV.

400. Schwarzschild's Ellipsoidal Theory. V. Nechvile. *Bull. Astronomique,* 6. 4. *pp.* 173–187, 1930. *In French.*—The author reviews his previous work [see Abstract 3073 (1927)]. This was provisional since the proper motions used were limited to those greater than $0''\cdot02$ per year. In the present investigation he examines the influence of such limitation, the essential point proving to be the discovery of certain partial frequency curves independent of the distribution of stars in space, and in this Schwarzschild's ellipsoidal theory alone can be accepted. These curves explain (as soon as a certain critical distance is determined) the apparent star streams observed, and also the dissymmetrical distribution of many stars. He develops these formulæ, and gives curves for a first series C_3, C_2, C_1 (for which the limiting value, ϵ, is $0''\cdot6$, $0''\cdot8$, and $1''\cdot0$ respectively) representing the primitive elliptical frequency curve (for $\epsilon = 0$) as of one curve with two ovoidal branches (with ϵ different from zero and increasing); and for a second series, E_1, E_2, E_3 (for which

$\epsilon = 1 \cdot 0$ invariably), representing the rapid and dissymmetrical change, which indicates the increasing magnitude of the components of the sun's motion of translation; the curve E_1 is identical with C_1. A. S. D. M.

401. Influence of Systematic and Accidental Errors on Velocity Ellipsoid. L. Hufnagel. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 22.*A*. 5. [9 *pp*.], 1930. *In German.*—Approximate calculation of the effects of accidental and systematic errors in the determination of the velocity ellipsoid for stars. The general case is dealt with, when the stars are not assumed to be all at the same distance away. G. C. McV.

402. Velocity Ellipsoid of Spectroscopic Binaries. H. Nordström. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 22.*B*. 4. [6 *pp*.], 1930. *In English.*—The velocity ellipsoid for the peculiar velocities of spectroscopic binaries calculated by Wallenquist is shown to be incorrect owing to an error in the calculations. The author calculates the correct values of the axes of the ellipsoid from data provided by 268 binaries and finds that it coincides with the ellipsoid found for stars in general. There is, however, a difference in longitude of 15° to 20° in the positions of the principal vertex of the two ellipsoids. G. C. McV.

403. Axial Rotation of Stars. O. Struve. *Astrophys. J.* 72. *pp*. 1-18, *July*, 1930.—The evidence for large stellar rotation (200 km./sec.) depends primarily upon the interpretation of stellar-absorption line contours. For this the factors of abundance of atoms and molecular Stark effect are negligible, and the axial rotation alone may be considered. The author takes the "dish-shaped" lines of B and A types in the Yerkes classification, and finds that rotational speed is a function of spectral type. He considers the micrometer tracings of the spectroscopic binary, α Virginis (a very young binary according to Jeans) and finds that one component is in rapid rotation while the other is not, and that the stronger component has the larger diameter and has an equatorial velocity of 200 km./sec., the smaller component having one less than 50 km./sec. He treats similarly the micrometer tracing of the "dish-shaped" lines η Ursæ Majoris (which is a single star of the α Virginis type and presumably of the same luminosity), and finds that this star also has an angular velocity of about 200 km./sec. He concludes that both these stars are rather close to the critical stage where break-up may occur, but does not draw any conclusion as to which is earlier in evolution. He computes the value of $\omega^2/2\pi\gamma\rho$, characteristic for the state of stability of a rotating star. A. S. D. M.

404. Space Motions of the Stars. R. E. Wilson and H. Raymond. *Astron. J.* 40. *pp*. 121–143, *Aug*. 26, 1930.—The now well-known asymmetry in the motions of the stars explains many of the discordant results obtained in the determination of the sun's motion in space and of the preferential motions of the stars themselves. Taking advantage of a wealth of data recently published, all available proper motions, radial velocities and parallaxes have been collected, and space motions for 4233 stars have been computed. A discussion of these shows that stellar motions are not in general distributed according to the ellipsoidal law, and that stream motion is apparent among stars of all speeds and types. Yet the existence of these streams, and the assumption of different mixtures in different regions of the sky, cannot account for the general asymmetry, which appears to be explicable only on the theory of general galactic rotation. Values of the rotation, determined from the radial velocities, are in good agreement with results of other investigators, the mean being + 0·015 km./sec./parsec. The period of rotation in the neighbourhood of the sun is 200,000,000 years, and the distance of the sun from the galactic centre is 8800 parsecs. To complete and confirm these results more and better proper motions must be collected, and this it is hoped to do in the near future. M. A. E.

405. Diffuse Matter in Interstellar Space. J. S. Plaskett. *Am. Acad., Proc.* 64. *pp.* 335–346, *Aug.,* 1930.—Investigation of the radial velocities of O-type stars at Victoria Observatory from 1920 onwards proved the existence of diffuse matter widely distributed through space, but it was at first thought to be at rest, with high-temperature stars moving rapidly through it in all directions. Eddington then developed a theory of the physical properties of such a diffuse matter, assuming that it was uniformly distributed [see Abstract 2310 (1926)]. Recent investigation conclusively demonstrates its uniform distribution throughout the stellar system, but it is not at rest. It partakes in the differential motions produced by a rotation of the galaxy. M. A. E.

406. Physics of a Star. J. Q. Stewart. *Am. Chem. Soc., J.* 69. 7. *pp.* 419–432, 1930.—A general account of the internal constitution of a star. The general opacity of a star is discussed, as well as the theory of selective opacity which accounts for the Fraunhofer lines as being due to scattering rather than to absorption. A speculative hypothesis with regard to the source of stellar energy is also advanced, *viz.* that an accelerated mass radiates energy proportional to its mass times the square of its acceleration. Such an hypothesis would easily give quantitative results, with regard to the amount of energy radiated, in agreement with observed values. G. C. McV.

407. Periods of Mira-Type Stars. F. Lause. *Roy. Astron. Soc. Canada, J.* 24. *pp.* 271–276, *July–Aug.,* 1930.—The author discusses, (1) the periods, (2) the remarkable changes in them. (1) It is difficult to classify those with periods between 50 and 90 days as being Cepheids or Mira-stars, or blends of the two types; with periods longer than 600 days we know of three, S Cassiopeiæ, RT Cephei and UX Sagittarii, as being Mira stars. For the intermediate periods he investigates in a table and a diagram, the frequencies which seem to follow a sine curve. The periods of stars with faint maxima seem short; 57 faint Milky Way variables have a mean period of 217 days as against 284 for all variables. Long-period variables are irregular in their variability. (2) Examples are given of slow continuous decrease and increase in the periods (R Hydræ and R Aquilæ); of periodic oscillation (R Aurigæ); and of *jump* in the epoch (R Aurigæ and V Coronæ Borealis). A. S. D. M.

408. Wolf-Rayet Stars. C. S. Beals. *Roy. Astron. Soc. Canada, J.* 24. *pp.* 277–281, *July–Aug.,* 1930.—Further discusses the theory of Wolf-Rayet emissions, which has been put forward independently by Menzel and the present author [see Abstract 1795 (1930)]. The theory suggests that conditions on the surface of a Wolf-Rayet star are such that gaseous material is continually being ejected in a radial direction and with high velocity into space. Obvious analogies between Wolf-Rayet spectra and the band spectra of Novæ gave rise to this theory. R. C. F

409. Spectrum of γ Geminorum (Class Ao). S. Albrecht. *Astrophys. J.* 72. *pp.* 65–97, *Sept.*, 1930.—A detailed study with at least 3-prism dispersion is needed for a typical star of each spectral class. Next to Class G (for which the K-term is practically zero), Class A is the simplest, and the author gives the result of spectrograms of γ Geminorum (Class Ao) taken at the Yerkes Observatory. There is a table of observed wave-lengths in the International system for over 900 lines between 4250 and 4723; the last column contains laboratory data for the identification of the observed lines, arranged either in order of decreasing importance or of increasing wave-length, but often merely at the laboratory lines nearest. In some multiplets {example Ti(I$f^5 - 2d^{15}$)} the stellar intensities do not follow the order of the laboratory, perhaps because of a quantum effect due to the complex gas mixtures. An inference has been drawn that because of its lower ionisation potential, Ti should be ionised to a greater extent than Fe at an A star's high temperature, and consequently neutral Fe should predominate over Ti. This is confirmed for γ Geminorum. The author suggests that, because of numerous secondary interrelations indicated between elements, a more fundamental relation than Bohr's atomic theory is required, whether it be in the nature of an actual transmutation of one element into another, or in the breaking down of all elements into one or more common, presumably identical, units of a lower order.
A. S. D. M.

410. Spectra of Ten Bright-Line Stars of Classes B and A. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 409. *Astrophys. J.* 72. *pp.* 98–110, *Sept.*, 1930.—Among the stars whose spectra have been found at Mount Wilson to exhibit bright hydrogen lines are a number with peculiarities of special interest. Ten of these are here briefly described.
AUTHOR.

411. Distribution of Stellar Absolute Magnitudes from the Distributions of Parallactic Motions and Radial Velocities. G. Strömberg. *Mt. Wilson Observat. Contrib. No.* 410. *Astrophys. J.* 72. *pp.* 111–116, *Sept.*, 1930.—The paper outlines a method for deriving the distribution of absolute magnitudes within a group of stars from the distributions of the reduced v-components of proper motions and of the radial velocities. The method is similar to that previously developed [see Abstract 3374 (1930)], which was based on the distribution of τ-components. [See also following Abstract.] AUTHOR.

412. Distribution of Absolute Magnitudes among M Stars Brighter than the Sixth Apparent Magnitude from Parallactic and Peculiar Velocities. G. Strömberg. *Mt. Wilson Observat. Contrib. No.* 411. *Astrophys. J.* 72. *pp.* 117–126, *Sept.*, 1930.—The distribution of absolute magnitudes among M stars brighter than the sixth apparent magnitude has been determined from the distributions of parallactic and peculiar reduced proper motions and the distribution of radial velocities. The methods used have been described [see preceding Abstract]. The number of proper-motion stars used is 247, and of radial-velocity stars 292. The distribution of absolute magnitudes shows two distinct groups: supergiants with a maximum frequency at absolute magnitude $-4 \cdot 5$ and ordinary giants around magnitude zero. The groups are separated by a clear gap around absolute magnitude $-3 \cdot 0$. The relative proportions of stars in the two groups are 9 and 91 % respectively. Numerical values

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are given which will enable one to compute the mean absolute magnitude from the mean apparent magnitude and the mean of the logarithms of the τ- or υ-components. AUTHOR.

413. Systematic Errors in Contours of Hydrogen Lines in A Stars. Emma T. R. Williams. *Astrophys. J.* 72. *pp.* 127–130, *Sept.*, 1930.—Evidence is adduced in support of the author's opinion that the systematic differences among the published contours of hydrogen lines are largely due to the judgment of the observer in estimating the position of the continuous background across the absorption line. AUTHOR.

414. Intensity of Hydrogen Lines as the Criterion of Luminosity for B, A and F Stars. Y. Öhman. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 22. *B.* 3. [6 *pp.*], 1930. *In English.*—Deals briefly with results of a spectrophotometric study of the B, A and F type stars in the Greenwich polar zone between 65° and 70° declination. The intensities of the Hγ, Hδ and K lines have been measured, as well as a colour equivalent for nearly 900 stars, and it is shown that the intensity of the H lines is a good criterion of luminosity for B- and A-type stars. Further, an increasing colour for A stars is followed by decreasing luminosity. The intensity of the H lines, combined with colour, form an excellent criterion of luminosity for A5–F8 stars, which are on the low temperature side of the H-line maximum. In this case decreasing line intensities correspond to decreasing luminosities, whilst decreasing temperature appears to correspond to increasing luminosity. The A0–A3 stars deviate somewhat from the other A stars, indicating two varieties of " hydrogen stars," this being further supported by a remarkable change in the velocity-ellipsoid when passing from A3 to A5 stars. R. C. F.

415. Hydrogen Lines in Two Galactic Clusters. C. J. Anger. *Harvard Coll. Obs., Circ. No.* 352. [9 *pp.*], 1930.—Since in star-clusters the absolute relative magnitudes are the same as the apparent, a study has been made of the contours and intensities of stellar hydrogen lines in Messier 7 and the Pleiades with the object of seeking an absolute magnitude criterion of A stars. A linear relation has been found between line width and total absorption, and total absorption is correlated with absolute magnitude for all spectral classes from B5 to A3; but although the correlation is similar in the two clusters, the zero point must be shifted. The correlation can be explained theoretically by an internal Stark effect. M. A. E.

416. Structure and Rotation of the Galaxy. J. S. Plaskett. *Am. Phil. Soc., Proc.* 69. 7. *pp.* 401–417, 1930.—Early conceptions of the Galaxy as an approximately uniform disc-shaped system of stars with the sun near the centre, and a diameter of some 7000 light-years, have now been replaced by Lindblad's suggestion of a number of concentric sub-systems surrounding a very massive central condensation. The sub-system nearest the centre is a disc-shaped aggregation of star-clouds which includes the solar cluster; outside this come the so-called " high-velocity stars " in an ellipsoid; and outside these the globular clusters in a scarcely flattened sphere. All the sub-systems are rotating round the massive centre, but with speeds increasing with nearness to the centre; and this explains the strongly flattened shape of the innermost sub-system, and also the frequent random or peculiar velocities of the outer objects and their apparent high velocities due to the sun's own rapid rotation. The diameter of the whole great system is about 200,000 light-years, and the sun has a velocity of 300 km./sec. with a period of about 230 million years. This hypothesis would explain the supposed asymmetry of the stellar velocities and the phenomenon of star-streaming. Oort calculated what the apparent stellar motions would be if the hypothesis were correct, and compared them with actual radial motions of distant objects such as O and B stars and planetary nebulæ. Plaskett and Pearce then added the radial velocities of several hundred more B stars, and proved conclusively the presence of a differential rotation in the Galaxy. Further, more accurate estimates of stellar distance have recently been made by observing the intensities of interstellar Ca lines, and these show the rotation even more clearly. M. A. E.

417. Absorption of Light in Space. P. van de Kamp. Astron. *J.* 40. *pp.* 145–159, *Sept.* 22, 1930.—Evidence for Trumpler's hypothesis of an absorbing medium concentrated in the galactic plane is given. In several galactic regions faint A and B stars show an increase of colour excess with distance. Bottlinger's colour indices of bright B stars reveal the same effect. The conclusion is that the differential absorption in galactic regions is of amount $+ {}^{m}0{\cdot}331 \pm {}^{m}0{\cdot}022$ per 1000 parsec. The change in observed absorption with galactic latitude for distant objects, such as globular clusters, faint B stars, etc., leads to the determination of the thickness of the absorbing layer, which is given as 175 ± 50 parsec. G. C. McV.

418. Non-Static Line Element for the Universe. R. C. Tolman. *Nat. Acad. Sci., Proc.* 16. *pp.* 582–594, *Sept.*, 1930.—Features of the non-static line element proposed by the author [see Abstracts 3093 (1930), 87 and 88 (1931)], by Robertson, by Lemaitre and by Friedman are discussed. Criticism of the author's previous work, by Eddington and de Sitter, is replied to. The author considers that the form of cosmological line element conforming best with our present knowledge of the universe is $ds^2 = -\{e^{2(kt+lt^2)}(dx^2 + dy^2 + dz^2)/(1 + r^2/4\mathrm{R}^2)^2\} + dt^2$, in which R, k and l are constant parameters. This corresponds to a uniform distribution of material in the universe, and nebulæ, with stationary coordinates x, y, z, remain so. In the case of an expanding universe, with $(kt + lt^2)$ positive and the accompanying red shift from distant sources, the proper motions of the nebulæ would tend to decrease with time. The present density of matter (ρ_0) and the pressure (p_0) are related to the parameters by the equation $4\pi(\rho_0 + 4p_0) = -2l + 1/\mathrm{R}^2$. The dependence of red shift on distance is approximately linear provided l is small. J. S. G. T.

419. Possibility of a Universe Having Infinite Mass. P. Lévy. *Ann. de Physique*, 14. *pp.* 184–190, *Sept.*, 1930.—A cosmology which attempts to avoid the dilemma associated with a universe of infinite mass, as customarily conceived, is briefly discussed. The main postulates of the theory are, (1) infinite masses are distributed in infinite space, (2) the mean density of the universe is zero, and (3) there are no regions in which the density is exceptional. J. S. G. T.

LIGHT.

420. Recrystallisation and Coloration of Rock-Salt. Part II. K. Przibram. *Akad. Wiss. Wien, Ber.* 139. 2. *A*. 5–6. *pp*. 255–270, 1930.—Extension of the recrystallisation time-pressure-temperature diagram of pressed rock-salt [see Abstract 105 (1930)] shows that after slight pressure (200 kg. per cm.^{2}) the work of liberating the ions is appreciably greater than at higher pressures (2000 and 5000 kg. per cm.^{2}). Direct micrometric measurement shows that the linear velocity of recrystallisation often remains constant for days, but is subject to sudden alteration. Measurements at temperatures up to 200 C.° give, for the van't Hoff coefficient, values in substantial agreement with those previously obtained. When the temperature is brought back to the room-temperature after heating, the recrystallisation velocity is smaller than before. The still growing inner boundary surfaces of the recrystallisation area are often distinguishable, owing to vivid reflections. The accelerating influence of slight radiation on the recrystallisation of the moderately compressed material, formerly assumed, is not confirmed, although the retarding influence of strong radiation on the highly pressed substance is always observed. In regard to recrystallisation, fusion crystals and also highly tempered natural rock-salt behave as though they contain many more recrystallisation nuclei than the untreated natural salt, but these nuclei show a less marked tendency to grow. T. H. P.

421. Colloidal Nature of Coloured Substances in Coloured Rock-Salt. M. Savostianowa. *Zeits. f. Physik*, 64. 3-4. *pp*. 262–278, 1930.—This work relates to theoretical considerations of optical phenomena of colloidal systems applied to the system Na–NaCl. Calculations are made for absorption and diffusion spectra for particles of various sizes and these deductions are compared with the experimental curves obtained by the present author for coloured rock-salt. It is found that the experimental data agree well with those deduced from the fundamental hypotheses. Except for the absorption maximum due to colloidal Na-particles, for yellow salt there is another maximum in the infra-red, the source of which has so far not been explained. J. K.

422. Definition of Saturation. C. Schaefer and H. Pese. *Phys. Zeits.* 31. *pp*. 720–737, *Aug*. 1, 1930.—After giving a general sketch of the formal definition of saturation in the three-component theory of colour vision, the author proceeds to criticise in detail Seitz's researches which claim to show the inadequacy of the theory in this respect. Seitz chose colour pigments from Oswald's atlas, to match mixtures of coloured lights of different hue, but the same saturation as defined in the three-component theory. These pigments, when compared together, seemed to Seitz to have widely different saturations. Computations here given show, however, that the pigments selected by Seitz did not in fact have the same theoretical saturations. Furthermore, the relative brightnesses of the pigments compared were widely different, and Seitz's judgments would be explained if he had confused brightness with saturation. It is concluded that Seitz researches do not in fact disprove the definition of saturation given by the three-component theory. A third section is concerned with an analysis of whiteness and saturation in the Oswald colour system and a critical comparison of these notions with the corresponding concepts of the three-component theory. W. S. S.

423. Visibility of Radiation and Dark Adaptation. R. A. Houstoun. *Phil. Mag.* 10. *pp.* 416–432, *Sept.*, 1930.—The relative visibility of the different colours of the spectrum at high intensities has been measured with great care by various observers at different times, and the results are in good agreement. When graphed against the wavelength they are not unlike the probability curve, though the general opinion has been that they have no connection with the latter. If, however, the results are graphed against log λ or log ν, or the logarithm of any power of λ, the shape of the curve is always the same; it seems then to express only a property of the eye itself. Evidence as to whether this is the case is brought forward from the experiments described by different observers. Equality of sensation can be determined by a photometer, but the absolute measurement of sensation cannot be effected in this way. It is necessary to consider the number of just perceptible increments between the degree of sensation in question and the threshold value. The state of adaptation of the eye must be taken into account. J. J. S.

424. Weber's Law and Visual Acuity. R. A. Houstoun and J. F. Shearer. *Phil. Mag.* 10. *pp.* 433–450, *Sept.*, 1930.—The authors describe measurements of the least difference of brightness perceptible in a simple test field, for red and blue light, over an intensity range of approximately 0·1 to 10,000 photons. Measurements of visual acuity were also made for white light in the range 10^{-3} to 10^4 photons. Correlation between the brightness difference threshold results and the acuity results is then attempted by assuming the brightness sensation proportional to the number of percipient elements stimulated in unit area; the acuity, on the other hand, proportional to the number of elements stimulated per unit length. Comparison with the experiments seems to support this suggestion. The effect on acuity of contrast in the test object is also discussed experimentally and theoretically. Some additional experiments on the least perceptible changes in brightness of a point source are used in an explanation of the accepted astronomical practice of grading the stars into six classes. W. S. S.

425. Redetermination of the Mixture Curves of the Spectrum. W. D. Wright. *Optical Soc., Trans.* 31. *pp.* 201–211; *Disc.*, 212–218, 1929–1930.—The paper describes a method that has been developed for calculating the sensation curves and mixture curves from an average set of trichromatic coefficients and the standard luminosity curve without recourse to any further experimental data. A complete table of colour-mixture data is given. The practical value of different methods of colorimetry and the most desirable primaries for use as reference standards are briefly discussed. [See also Abstract 3306 (1929).] AUTHOR.

426. Reflectivity of Land Surfaces. H. H. Kimball and I. F. Hand. *Monthly Weather Rev.* 58. *pp.* 280–281, *July*, 1930.—In continuation of work previously described [see Abstract 981 (1930)] the authors give the results of measurements of reflection factors made from an aeroplane using L. F. Richardson's photometer. The types of surface measured included the following: city, park, snow on field (up to 89 %), forest, river and sea (Chesapeake Bay). A few attempts were made to obtain values of the reflection factors in different parts of the spectrum. J. W. T. W.

427. Measurement of Lustre of Textile Fibres. M. O. Pelton. *Optical Soc., Trans.* 31. *pp.* 184–196; *Disc.*, 197–200, 1929–1930.—The lustre of textile fibres is due to a geometrical property of transparent cylindrical filaments with polished surfaces. Some of the factors, notably double refraction and diffraction, which might affect lustre are discussed, and a method is suggested for measuring lustre based on the high lights visible on a curved lustrous surface. AUTHOR.

428. Dispersion of Light in Metals. J. B. Nathanson. *J.O.S.A.* 20. *pp.* 469–483, *Sept.*, 1930. *Presidential Address, Phys. Soc., Pittsburgh.*—Starting with the classical theory developed by Maxwell, Drude and Lorentz, Ruedy's recent work [see Abstract 1775 (1929)] on the computation of the relative number of free and bound electrons in the metal is described. In the infra-red the simple Maxwell theory is in good agreement with experimental results, but if applied to shorter wave-lengths it breaks down so soon as the conductivity of the metal becomes of importance. Reference is made to modern work in this field. The author next describes the attempt of Kronig [see Abstract 3258 (1929)] to apply Bloch's ideas of electrical conductivity [see Abstract 1449 (1929)] to a determination of the optical constants of metals, which leads to results of the correct magnitude. For X-rays a simplified Lorentz expression is found to be satisfactory and the work of Forster [see Abstract 845 (1929)] in this connection is described. The agreement is not good in the neighbourhood of an absorption edge, and a new quantum theory of X-ray dispersion in metals has been developed by Kramers and others. An expression derived by Kronig [see Abstract 2622 (1926)] is supported by some experiments, while the Lorentz theory seems to be favoured by others. Until more data are available it is not possible to decide between them. C. B. A.

429. Artificial Anisotropy and Optical Activity of Silver Photochloride. J. P. Mathieu. *Rev. d'Optique*, 9. *pp.* 353–375, *Sept.*, 1930.—Silver chloride which has been previously exposed to sunlight acquires permanent linear dichroism and birefringence when exposed to the action of plane-polarised light (Weigert effect). Exposed to circularly polarised light, it acquires circular dichroism and becomes optically active (Zocher effect). The experiments of Weigert and Zocher are repeated and extended with various silver chloride preparations. The progressive establishment of the anisotropies, their variation along the visible spectrum, the influence of a magnetic field on the development of the Weigert effect, and the *rôle* of fixing and of oxidation of the sensitised films are studied. Full experimental details of the preparation of the films and the investigation of their optical properties are given. Examination of the results suggests that the changes produced by polarised light consist of modifications in the internal structure of ultramicroscopic particles according to certain conditions of symmetry, but there is little positive evidence as to the mechanism of this. C. B. A.

430. Physical Identity of Enantiomers. A. N. Campbell and F. C. Garrow. *Faraday Soc., Trans.* 26. *pp.* 560–564, *Sept., and p.* 565, *Oct.*, 1930.—*D*- and *l*-mandelic acids have been prepared in a state of purity and their melting points, rotatory powers, rotatory dispersions and solubilities compared. Slight but distinct differences are shown to exist. The theoretical implications of these results are discussed. AUTHORS.

431. Magnetic Birefringence of Phenol, Naphthalene and Phenanthrene Liquefied by Fusion. C. Salceanu. *Comptes Rendus*, 191. *pp.* 486–488, *Sept.* 22, 1930.—The magnetic birefringence for the yellow mercury line varies for phenol, from 1·12 at 47° C. to 0·80 at 118° C.; for naphthalene, from 3·83 at 88·5° C. to 3·05 at 169° C., and for phenanthrene, from 7·92 at 102° C. to 7·09 at 129·5° C. The ratio between the values for the green and yellow mercury lines is: for phenol, 1·045 at 49° C.; for naphthalene, 1·10 at 106° C., and for phenanthrene, 1·075 at 104° C. [See Abstract 2799 (1930).] T. H. P.

432. Iridescent Colours of Birds and Insects. (Lord) Rayleigh. *Roy. Soc., Proc.* 128. *pp.* 624–641, *Aug.* 5, 1930.—The reflection spectra in the ultra-violet of Morpho butterflies and Urania moths show maxima in general agreement with the theory of interference. No Morpho butterflies show blue colour by transmission, but they do show brilliant diffraction spectra. Moist chlorine gas does not destroy the colours, although it bleaches the black background. On the other hand, colours of peacock's feathers are faded by light and by chlorine. It is concluded that colours stable to chlorine are not due to pigment. F. S.

433. Optics of Opaque Films. P. Gruner and M. Grütter. *Helv. Phys. Acta*, 3. 7. *pp.* 477–500, 1930.—The effect of a homogeneous plane parallel film of an opaque medium on light transmitted through it is investigated and discussed mathematically. The resulting formulæ allow of the determination of the influence of pure film effect on the light scattering at a single particle. [See also Abstract 769 (1929).] C. B. A.

434. New Micro-Kinematograph. J. Comandon. *Soc. Franç. Phot. et Ciné., Bull.* 72. *pp.* 182–188, *June*, 1930.—An account of an apparatus, suitable for taking photographs of living organisms, in which the camera is replaced by a kinematograph. Light from the positive crater of a 20-ampere arc lamp is received on the mirror of a microscope and traverses a solution of copper sulphate to absorb most of the long waves. The condenser of the microscope projects the light on to the substance under observation. The kinematograph is driven by a $\frac{1}{2}$-h.p. motor with a wide range of speed variation. The light reaching the living organisms is reduced to a minimum by the use of a field diaphragm, so that it only illuminates the portion to be photographed. Also the light cover is placed in front of the microscope. The special feature of the instrument is the arrangement for rapid change of the films, the time for which is only about $\frac{1}{500}$ second, whereas the time of exposure is much longer, resulting in the use of a less intense illumination. It is, however, possible to take as many as 32 impressions per minute. In many observations of the slow changes of certain living organisms it is possible to reduce the records to one every two minutes. As the records may take many hours to make, the arc lamp is then replaced by a 12-volt, 100-c.p. automobile lamp. The microscope is usually placed in an electric stove maintained at a constant temperature of 50° C. and the whole of the apparatus is protected from vibration. W. C. S. P.

435. Logarithmic Wedge Sector and its Use in Quantitative Spectrum Analysis. F. Twyman and F. Simeon. *Optical Soc., Trans.* 31. *pp.* 169–181; *Disc.*, 181–183, 1929–1930.—A logarithmic wedge sector is described and its method of use and a number of factors which need attention in this connection are considered. A discussion of the validity of the law of reciprocity in the case of intermittent exposure is given. The application of the apparatus to quantitative spectrum analysis is indicated. AUTHORS.

436. Modification of Michelson's Beam Interferometer. E. H. Synge. *Phil. Mag.* 10. *pp.* 291–297, *Aug.*, 1930.—The length of the beam in Michelson's instrument cannot be increased indefinitely for mechanical reasons, and so the resolving power is limited. It seems possible to substitute two small cælostats placed, so that their axes (polar axes) form part of the same geometrical right line, on a hillside with a north-south slope equal to the latitude. The reflecting surfaces can be set so as to form parts of the same plane, and for purposes of stellar interferometry the arrangement forms virtually one cælostat of almost unlimited size. They can be used with accessory plane mirrors, and a fixed telescope, to obtain a resolving power which is proportional to the distance between the cælostats multiplied by the cosine of the declination of the star. The accessory plane mirrors must be adjusted so that the two beams from the star ultimately pass down the sides of the telescope and arrive together at the centre of its focal plane, with equality of optical path lengths as measured from any arbitary wave front in space. The stellar diameters which can be measured are north-south diameters, and no others; this will as a rule be of little consequence. Suggests the desirability of conducting the beams to the telescope from the cælostats through partially evacuated pipes to avoid disturbance of the interference fringes. H. N. A.

437. Vacuum Grating Spectrograph. F. Simeon and C. F. Smith. *Rev. Sci. Instruments*, 1. *pp.* 512–516, *Sept.*, 1930.—A vacuum-grating spectrograph is described in which adjustment is simplified by having the slit mounted in a side tube. The central image is focussed at one end of the photographic plate, its position being brought coincident with the hinge. The tilt of the plate can be adjusted without evacuation. A special feature is the movement of the plate *in vacuo* by a mechanical movement, thus allowing several spectra to be recorded. F. S.

438. Molecular Movements in the Illuminated Image Ultramicroscope. H. Siedentopf. *Kolloid Zeits.* 52. *pp.* 257–262, *Sept.*, 1930.—A detailed description of a new form of ultramicroscope, making use of light obtained by total reflection to illuminate the layer under observation, is given. Advantages over both the Siedentopf and Zsigmondy and the cardioid ultramicroscopes are claimed for it, in particular that the depth of the illuminated layer—about 1μ—is constant and known; that the vertical component of molecular motion can be determined; and that magnification up to 2100 times with a clear picture is obtainable. The instrument is specially suitable for observing molecular movements, *e.g.*, in a silver sol or living bacteria. C. A. S.

439. Theory of the Bosshardt Zeiss Double Image Tachymeter. V. Theimer. *Zeits. f. Instrumentenk.* 50. *pp.* 493–511, *Sept.*, 1930.—Gives the theory governing this instrument, in which a horizontal scale is viewed through the upper half of the objective of the telescope directly, while through the lower half it is seen with a deviation to one side, due to two small angled prisms, forming a "rotating wedge." The two prisms are geared together in such a way that, when the one nearest to the objective is rotated through the angle ρ, the other is rotated in the opposite direction through the angle 2ρ. The result is that the deviation of the line of sight from the direction of the axis of the telescope can be gradually varied through a certain range. The arrangement is geared to the circle on which the altitude of the telescope axis is read off, so that the deviation of the line of sight depends upon the attitude. Matters are so arranged that the *horizontal* distance of the staff from the telescope can be read off on the scale marked on the staff by means of the two images seen. H. N. A.

440. New Self-Reducing Triple Image Tachymeter. R. Hugershoff. *Zeits. f. Instrumentenk.* 50. *pp.* 526–530, *Sept.*, 1930.—Uses three parallel telescopes with a common eyepiece. No. 2 views the staff directly while the rays coming through 1 and 3 are reflected by means of two separate pairs of reflecting prisms into the eyepiece. Before 1 and 3 are mounted two pairs of glass wedges with equal angles; one of each pair is fixed, say, with its edge in the horizontal direction, the other is turned about the optical axis of the telescope automatically when the elevation of the telescope is altered. There is a similar arrangement in front of the other telescope with the edge of the fixed wedge in the vertical direction. The horizontal distance and the elevation of the station observed can be read off on the images of the staff formed in the common field of view side by side with one another. H. N. A.

441. Optical and Photographic Properties of Certain Groups of Sensitising and Desensitising Dyes of the Cyanine and Related Types. O. Bloch and Frances M. Hamer. *Phot. J.* 70. *pp.* 374–390; *Disc.*, 390, *Aug.*, 1930.—Further experiments, similar to those already described [see Abstract 1249 (1928)], show that the absorption bands of the styryl compounds and of the anils are broader than those of the cyanines and, with one observed exception, are single, whereas some of the cyanines show double-banded absorption. With the compounds now examined, the absorption maximum of every styryl compound is nearer by $25 - 60\mu\mu$ to the blue end of the spectrum than that of the corresponding anil. With distyryl and dianil derivatives the absorption bands are particularly broad, and that of the former compounds shows a second maximum. Six of the cyanines tested have the principal absorption band nearer to the blue than that of the corresponding styryl compound, but the reverse is the case in two instances. With some cyanines, change occurs in the positions of the absorption bands with the concentration of the solution. With chloride emulsions a "shadow" spectrogram is produced when the solutions used are those of the iodide of the dye, owing apparently to the formation of traces of a silver chloro-iodo complex having a spectral sensitivity different from that of either the chloride or iodide separately. T. H. P.

442. Sensitivity of Photographic Emulsions to X-Rays. J. Eggert. *Zeits. f. Elektrochem.* 36. *pp.* 750–753, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June*, 1930.—Examines the sensitivity of six emulsions with regard to the relationship between sensitivity to X-rays and the grain size. The emulsions had different grain masses "m," but were all of the same type, and the results obtained show that the photographic action of the X-rays is approximately proportional to $m^{2/3}$, this proportionality being valid only for emulsions of the same type. There are many indications of similar photographic actions due to X-radiations and light although the physical properties of these two radiations possess characteristic differences. Three important photo-

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graphic properties which indicate this similarity are desensitisation, the shape of the blackening curves and the temperature relationship of the sensitivity. R. C. F.

443. Light from Burning Magnesium Ribbon and Flash-Light Powder. H. Arens and J. Eggert. *Zeits. f. wiss. Phot.* **28.** *pp.* 169–177, *Sept.*, 1930.—Discusses objections raised by Eder against the present authors' previous work on the actinity and colour temperature of the light from burning magnesium ribbon and flash-light powder. Eder maintained that the actinity of the light from the ribbon for pure silver bromide without glass filtration was some 10 % too low, but this is shown to be an incorrect assertion owing to different experimental conditions in the two cases. Eder himself has previously shown that, for orthochromatic layers the actinity of the light from the ribbon, with glass filtration, can be approximately the above-mentioned value lower than without glass filtration. In the majority of cases examined the actinity of the powder light is found definitely to be higher than that of the ribbon light, so that Eder's statement regarding the incorrectness of this appears hard to agree with. These results of Eder, which are connected with the ratio of the colour temperatures, are discussed and shown to be probably erroneous. Finally, a correction of the colour temperature of the powder light is found to be necessary without affecting the measurements previously made, and the new value of 3350° Abs. instead of 2900° Abs. is in agreement with Eder's contention that the latter value is too low. [See Abstract 2511 (1930).] R. C. F.

444. Ur-Silver Content and Nucleus Formation in Photographic Emulsions. H. Arens and J. Eggert. *Zeits. f. wiss. Phot.* 28. *pp.* 178–190, *Sept.*, 1930.—Examines the measurements of Weigert and Lühr [see Abstract 2510 (1930)], considering various aspects. The two analysis methods were first brought into agreement by an interchange of results, and these then showed that for Valenta copying papers an increasing quantity of ur-silver is obtained which is dependent upon the time of keeping. A repetition of Weigert's work on normal photographic layers shows considerable fluctuations in the ur-silver values, thus indicating that the silver thio-sulphate complex of the ur-silver content of the layer, which enters with fixation, cannot have one meaning only. Weigert and Lühr's value for the ur-silver quantity in normal photographic layers is shown to be too high, and this is further supported by a comparison with the silver quantity which was obtained from the present authors' previous results, a similar result being obtained from purely theoretical considerations. A comparison of the ur-silver content with the quantities of known substances producing an increase or a decrease in sensitivity of the photographic layers leads to the conclusion that the former quantity also is too high. This is supported by a comparison with the same quantities of colloidal silver of a dispersive power of the same value. These investigations, from the classical silver nuclei theory of the latent image, indicate the unsuitability of Weigert's new micelle theory of the latent image.
R. C. F.

445. Herschel Effect. J. Narbutt. *Zeits. f. wiss. Phot.* 28. *pp.* 191–220, *Sept.*, 1930.—Although a large amount of work has been done on the Herschel effect no suitable explanation thereof has as yet been given. This is due to the neglect of previous authors to undertake an extensive comparative study of the causes which give rise to this effect. The present author attempts to overcome this difficulty by such an examination of the production or non-production of this effect, for a large number of different commercial plates and papers, which are subjected to widely differing initial treatments. It is well known that there exists a relation between the Herschel effect and desensitisation or sensitisation, and results are given for a large number of salts showing which influence the starting and magnitude of the effect, and by how much. The bleaching effects of green, blue and ultra-violet light are also examined for one type of plate, namely, the least sensitive of those used previously. Finally, the results obtained are theoretically discussed, it being considered that Trivelli's theory A → B → C is satisfactory, excepting that B requires to be defined as the chemically developable substance and C the substance not chemically developable. A is the silver halide. R. C. F.

446. Action of Temperature on the Photographic Plate. N. Barabascheff and B. Semejkin. *Zeits. f. wiss. Phot.* 28. *pp.* 221–228, *Sept.*, 1930.—Photographic photometry can be seriously affected by systematic or accidental errors, the latter, however, being removed by the average of the results from a number of exposures. Temperature effects are generally systematic causes of error, and the present authors examine the effects of temperature on photographic plates in order to illustrate the corrections which may be necessary. A falling temperature causes a lowering of the gradation curve of the plate. It is shown that this decrease in photographic density with decreasing temperature is independent of the order in which the photography is done. This means that an exposure at a normal temperature followed by one at a low temperature shows, after development, the same effects as are shown by a plate exposed in a low temperature and then taken into the normal temperature for the second exposure. Thus in the use of photographic plates for photometric purposes it is necessary to copy the reduction scales at the same temperature as that at which the object itself is photographed.

R. C. F.

447. Anti-Fogging Agents in Developers. A. P. H. Trivelli and E. C. Jensen. *Frank. Inst., J.* 210. *pp.* 287–309, *Sept.*, 1930. *Comm. No.* 440. *from the Kodak Research Lab.*—The present authors give the results of an investigation of the anti-fogging action of certain substances when used in the developer instead of in the photographic emulsion. It is shown that 6-nitrobenziminazole is a better anti-fogging agent when used in hydroquinone, pyrogallol and *p*-aminophenol developers than are either potassium bomide or iodide. In these developers it gives the least image depression with the same fog-removing qualities, and with *p*-aminophenol developer fog was removed without change of density up to 12 minutes development at 20° C. Certain results obtained with negative film indicate that this anti-fogging substance generally does not produce such good results as potassium bromide. If used in still weaker concentrations in the developer it appears that as good results will be obtained over the whole density range as are given by the bromide.

R. C. F.

448. Photochemistry of Alkali- and Silver-Halide Crystals. R. Hilsch and R. W. Pohl. *Zeits. f. Physik*, 64. 9–10. *pp.* 606–622, 1930.—The paper gives a description of experiments carried out on alkali and silver halides with the object of extending the observations of Goldstein in 1896 on the coloration of the alkali-halides by light, and the formation of the latent image in photographic emulsions of silver halides. The work was limited to the wave-lengths in the region of the latent image formation. The earlier work of B. Gudden and R. W. Pohl [see Abstract 371 (1926)], is referred to and corrected. Absorption curves are given showing the results obtained. The subjects discussed in the paper are: (1) the coloration of the crystals, (2) the absorption spectra of the colour-centres, (3) the number of colour-centres per unit volume, (4) the photochemical yield, (5) visibility of the latent photographic image, (6) the irreversible destruction of colour-centres by light, (7) the reversible elimination of colour-centres by stimulation, (8) the nature of colour-centres, and (9) effect of temperature and concentration. The authors conclude that the photochemistry of the alkali-halides is a simple type of photography. [See also Abstract 2164 (1930).] T. B.

449. Quenching of Fluorescence of Dyestuff Solutions by Electrolytes. A. W. Banow. *Zeits. f. Physik*, 64. 1–2. *pp*. 121–134, 1930.—Wawilow's theory [see Abstract 3216 (1928)] that the quenching is due to collisions of the second kind is not in accord with experimental results. A further cause is sought in the salting-out effect of the electrolyte. By this is meant the reduction in the available dilution introduced by the presence of the electrolyte. The experimental evidence for this is: (1) the quenching effect is most marked when the electrolyte is added to a solution whose concentration is already near the optimum, in many cases the addition of electrolyte to a very dilute solution having no appreciable effect; (2) this latter fact eliminates both the possibilities of collisions of the second kind and of chemical action; (3) a definite relation exists between quenching effect and concentration of electrolyte given by $L/L_0 = e^{-k\sqrt{c}}$, where L and L_0 refer to quenched and unquenched fluorescence; (4) the electrolyte produces exactly the same kind of change of absorption spectrum as increased concentration. Since the decrease in available volume per c.c. introduced by the electrolyte is $4/3\pi(R + r)^3$ a comparison of the concentrations of quenched and unquenched solution giving equal brightness obviously gives the sum of the radii of the dyestuff molecules (R) and electrolyte ions (r). The values deduced from the experiments for the radii of dyestuff molecules agree fairly well with those deduced from the Einstein diffusion formula. J. E.

450. Effect of Electric Field on Resonance Fluorescence. M. Winkler. *Zeits. f. Physik*, 64. 11–12. *pp*. 799–805, 1930.—Experimental determinations of the polarisation of the resonance fluorescence of Na vapour with and without an electric field are described. Observations perpendicular to the electric field showed a small but definite polarisation (9 ± 3 % for a field of 21,000 volts cm.$^{-1}$) in accordance with theory. Observation parallel to the electric field indicated a reduction in the polarisation which is only possible if the circular components, split in the electric field, are non-coherent. This result, which agrees with previous work by Hanle on the mercury resonance line, is in contradiction to theory. W. S. S.

451. Quenching of Calcium Phosphors, with Special Reference to Mixed Phosphors. F. Bandow. *Ann. d. Physik*, 6. 4. *pp*. 434–457, *Sept*. 4, 1930.—Investigations on CaS-Bi-α phosphors show that the long wave quenching maxima are unaffected by different methods of preparation, even though other properties of the phosphors are markedly affected. The conditions for the passing over of the selective quenching effect to a general one are not yet known. A comparison of the light sums, centre distribution, and quenching effects of sulphide, oxide and mixed phosphors indicates that centres in the mixed phosphors attributed to oxide centres may be sensitised by the presence of the sulphide centres. J. E.

452. Band Width and Temperature Relations of the Emission Bands of the Alkali-Halogen Phosphors. F. Urbach. *Akad. Wiss. Wien, Ber.* 139. 2.*A*. 7–8. *pp*. 349–352, 1930.—The theory of the author on the absorption bands and emission bands of solid bodies [see Abstract 169 (1930)] has recently been supported by the results of W. v. Meyer on the alkali-halogen phosphors. Within the limits of error the forecasted relation between the band widening with temperature and the band shift is fully confirmed. J. E.

453. Luminescence of Alkali Halides. Parts I and II. F. Urbach. Part III. F. Urbach and G. Schwarz. *Akad. Wiss. Wien, Ber.* 139. 2.*A*. 7–8. *pp*. 353–372, *and* 483–495, 1930.—Part I deals with the scope of the work and gives a number of general results on the luminescence of alkali halides after radiation with radium rays. The light sum obtained by light excitation is greater than by heat excitation. If the light excitation is interrupted, the brightness on a second application of the exciting light is appreciably greater than before the interruption. Pressure and heating can both suppress certain centres and bring out new centres. An estimate of the absolute value of the light sum gave a value of the number of centres which is of the order of 10^{-8}. In Part II the photoelectric cell arrangement for measurement of luminescence is described, and its application to the confirmation of some of the above results is given. The enhancement phenomenon (increase after interruption) is quantitatively confirmed, as is also the twofold nature of the emission with rock-salt previously observed. Slow heating indicates the existence of three centres. A theory of thermoluminescence is developed assuming that the transition from the excited to the unexcited state with emission necessitates surmounting of an energy barrier W. The value obtained is of the same order as the work of dissociation. Part III deals principally with the thermoluminescence of rock-salt. The results of the visual observations given in the first paper are quantitatively confirmed with the photo cell. One part of the multiple thermoluminescence is completely reversible by light excitation and corresponds to a transition from the excited state, while another part of the thermoluminescence is attributed to a change in the excitable state associated with coloration of the salt. The temperature effects lead to the hypothesis of weak spots as thermoluminescent centres, the life of these weak spots being very much dependent on temperature. The number of weak spots depends at high temperatures on the existing temperature mainly and at low temperatures on the original state and former history of the substance. J. E.

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454. Stokes' Law. F. Urbach. *Akad. Wiss. Wien, Ber.* 139. 2.*A*. 7–8. *pp*. 473–481, 1930.—After a short historical survey, a hypothetical experiment is suggested with an ideal fluorescent substance. It is shown that Stokes' law is a consequence, in this case, of the second law of thermodynamics. The exceptions to Stokes' Law are considered and a general mechanism of luminescence which includes these is given based on the

Einstein quantum treatment of absorption and emission together with the assumption of a difference of energy level between the final state of absorption and the initial state of emission. J. E.

455. Line Emission of Solids and Chemical Combination. R. Tomaschek. *Zeits. f. Elektrochem.* 36. *pp.* 737–743; *Disc.*, 743, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June*, 1930.—A summary is given of published results concerning the spectrum of samarium in phosphors. The chemism of phosphor-formation depends on an embedding (not a building-in) of the molecules of the heavy metal compound in the lattice of the micro-crystal region of the fundamental material, such a disturbed region with an embedded luminous complex being termed a phosphorescence centre. It must not be assumed that the heavy metal atoms are built into the lattice, although the heavy metal compound causes deformation of the crystal lattice and so gives rise to the characteristic exciting absorption of the centres. The mechanism of the phosphorescence depends on a shock transference of the energy of the excited microcrystalline region to the heavy metal compound. Various consequences of these views are discussed. T. H. P.

456. Absorption Spectra of Organic Compounds at Liquid Air Temperatures. J. B. Conant and F. H. Crawford. *Nat. Acad. Sci., Proc.* 16. *pp.* 552–554, *Aug.*, 1930.—The visible absorption spectra at low temperatures of solutions of porphyrins and certain other coloured organic compounds (chlorin *e*, bilirabin and pinacyanole) have been examined to see if certain bands are resolved into narrower bands. This phenomenon was observed for the porphyrins but not for the other substances. From the data obtained it seems probable that the phenomenon of resolution of bands at low temperatures may be characteristic of compounds having certain cyclic systems. H. H. Ho.

457. Absorption Spectrum, Molecular Volume and Refraction of Neodymium Perchlorate. P. W. Selwood. *Am. Chem. Soc., J.* 52. *pp.* 3112–3120, *Aug.*, 1930.—Deformation of the electron shells of the neodymium ion is investigated from the standpoints of absorption, molecular volume, and molecular refraction changes. Experimental details of the measurement of these properties, and analysis of the materials, are given. For solutions of neodymium perchlorate, increasing concentration is associated with an increase in volume and refraction, and with a slight shift of the absorption bands towards the red. These results agree with deductions from the Clausius-Mosotti theory of dielectrics and with recent observations by Fajans and Ephraim. C. B. A.

458. Effect of Pressure on Absorption of Spectral Lines. S. Datta and S. N. Roy. *Indian Journ. Phys.* 5. *pp.* 365–370, *Sept.* 15, 1930.—The absorption of potassium vapour was studied with a quartz spectrograph, using a carbon arc fed with uranium compound as source. By adding nitrogen it was shown that the absorption depends upon the total pressure and not upon that of the potassium vapour alone. F. S.

459. Ultra-Violet Spectroscopy of the Flames of Motor Fuels. Part V. Analysis of Gasoline for Iron Carbonyl by Means of a Small Quartz-Prism Spectrograph. G. L. Clark, V. R. Hardy and H. B. Willman. *J. Phys. Chem.* 34. *pp.* 1924–1929, *Sept.*, 1930.—Iron carbonyl is well known as an anti-detonating agent in motor fuels. The apparatus and procedure used in its analysis are essentially the same as in the work described in Part IV [see Abstract 3053 (1929)]. It is shown that the ultra-violet spectra of gasoline flames serve as accurate and sensitive means of analysis for iron carbonyl in the gasoline. A small Gaertner quartz-prism spectrograph can detect iron carbonyl in gasoline down to a concentration of $6 \cdot 2 \times 10^{-7}$ gm. of Fe per c.c. of solution, while a larger Bausch and Lomb spectrograph will detect it down to about $5 \cdot 4 \times 10^{-7}$ gm. per c.c. Forty-three iron lines are obtained at the higher concentrations of $Fe(CO)_5$, of which one ($\lambda = 2450 \cdot 4$) has not previously been identified in either flame spectra or the spectrum of an electric furnace, while 14 other lines have never before been identified in a flame. T. B.

460. Measurement of the Reflecting Power of Glowing Tungsten in the Ultra-Violet. E. Spiller. *Zeits. f. Physik*, 64. 1–2. *pp.* 39–42, 1930.—The energy distribution in the radiation from a 300-watt Nitra lamp is determined in the wave-length range 4000 Å. to 3400 Å. A good agreement is obtained with the values calculated from the Wien-Planck radiation formula for a definite colour temperature of the lamp. The emissivity of glowing tungsten at 2100° Abs. is determined between 4360 Å and 2700 Å. The experimental method used is that described by Forsythe and Worthing. C. B. A.

461. Oscillation-Rotation Spectrum of Acetylene. Part I. Band Analysis. K. Hedfeld and R. Mecke. Part II. Intensity Measurements. W. H. J. Childs and R. Mecke. Part III. Proper Frequencies of Simple Symmetrical Molecules. R. Mecke. *Zeits. f. Physik*, 64. 3–4. *pp.* 151–185, 1930.—The spectrum between λ9000 and λ7000 was photographed under high dispersion, bands being found at λλ7887, 7956 and 8622. These were measured and analysed with relation to the combination conditions. Accurate intensity measurements of the λ7887 band were made, and the results are discussed. It is shown that the proper frequencies of a molecule can be denoted by valence-oscillations and deformation-oscillations. A rod-like molecule has $(n - 1)$ of the former and $(n - 2)$ of the latter. The following symmetrical molecules are then discussed—CO_2, N_2O, CS_2, C_2H_2, $(CN)_2$ and H_2O_2. F. S.

462. Changes of the Oscillation Bands of the Ammonium Radical Near the Transformation Temperature. Liselotte Wilberg. *Zeits. f. Physik*, 64. 5–6. *pp.* 304–324, 1930.—The work described bears on the problem of the transformation or rearrangement of the NH_4 radical which is known to occur in the neighbourhood of −30° C. The infra-red absorption spectrum of ammonium chloride, in the spectral range $0 \cdot 80\,\mu$ to $16 \cdot 0\,\mu$ at room-temperature, and $3 \cdot 10$ to $16 \cdot 0\,\mu$ at a temperature of about −50° C., was determined using the method and apparatus previously employed by Hettner and Simon. In addition to these "isothermal" measurements, two "isochromatic" series were taken for wave-lengths $\lambda = 5 \cdot 60\,\mu$ and $\lambda = 6 \cdot 95\,\mu$, the temperature varying from 20° C to −70° C. These latter measurements gave an abrupt variation in the absorption at − 30·3° C. The isothermal series showed the existence of three groups of bands for which the intensity (*a*) increased, (*b*) remained unchanged and (*c*) decreased in passing from room-temperature to − 50° C. An explanation of the experimental results is put forward, assuming the existence of two quantum states of the ammonium radical. Of the above three groups of bands, the (*a*) group is ascribed to the lower

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quantum state, the (*c*) group to the upper state, and the (*b*) group in common to both states. W. S. S.

463. Broadening due to Collision in the Rotational Spectrum of Gases. W. Lasareff. *Zeits. f. Physik,* 64. 9–10. *pp.* 598–605, 1930.—After a short introduction, in which the author states the results which have been obtained as to the causes of the broadening of the spectral lines [see Abstract 2168 (1930)], he describes the method he used to ascertain the causes of the broadening. To prove the existence of the coupling effect as simply as possible, the effect of a non-absorbing dipole-gas (HBr say) on the absorption of another dipole gas (HCl) was investigated. The results obtained were compared with those obtained by compressing the absorbing gas (HCl), keeping the product of the length of column and density constant. The experiment was then repeated at such wavelengths that HBr absorbs and HCl is the indifferent gas. Coupling would be indicated if in both cases the broadening due to compression was appreciably greater than when the second gas was added. On the other hand, collision broadening would be present if the effect of the added gas were the same as that of the absorbing gas on itself. The source of light was a Nernst burner and the prism of the spectrometer was a 60° fluor-spar prism; the radiation intensities were measured by a Rubens micro-radiometer. The method of preparing and purifying the gases is described. Curves and tables of results are given, and the conclusion is reached that collision is the essential cause of the broadening of the lines. The absorption was measured in the infra-red, *i.e.*, at $3 \cdot 46\,\mu$ for HCl, $3 \cdot 9\,\mu$ for HBr, and $2 \cdot 73\,\mu$ for CO_2. T. B.

464. Influence of Temperature on Absorption Spectra of Alkali Halide Crystals. H. Fesefeldt. *Zeits. f. Physik,* 64. 9–10. *pp.* 623–628, *and* 11–12. *pp.* 741–748, 1930.—The part of the absorption spectrum which is accessible in air is investigated for rubidium bromide and potassium iodide over the range of temperature from + 220 to — 253° C. The thin films of crystal are prepared by condensation of the vapour *in vacuo* according to the method of Hilsch and Pohl, of whose work the present paper is an extension [see Abstract 634 (1930)]. The position of the first energy level, measured in volts, is found to be displaced linearly with temperature. This displacement explains the strong temperature refraction coefficient of the alkali halides. In the second paper measurements are extended to halogen compounds of lead, thallium, cadmium, zinc, barium, nickel, cobalt and indium. The influence of temperature on the absorption spectra is investigated. The results indicate that the majority of crystals of simple chemical composition show definite band spectra, but that the bands cannot be resolved, even at low temperatures. Well separated energy levels seem to occur only in crystals of particularly simple ionic linkage. C. B. A.

465. Temperature Radiation of Non-Metallic Bodies, Especially Oxides. F. Skaupy and G. Liebmann. *Zeits. f. Elektrochem.* 36. *pp.* 784–785, *Sept.,* 1930. *Paper read before the Deut. Bunsen. Gesell., Heidelberg, May–June,* 1930.—The paper opens with a discussion on the relative behaviour of metallic and non-metallic substances in regard to the emission and absorption of radiation. A convenient method of investigating the radiating properties of non-metallic oxides, such as aluminium oxide, is to place a layer about $0 \cdot 5$ mm. thick on a Nernst glower and compare the radiation from the substance with that of the glower, the temperature being obtained by optical measurements. Curves are given showing how the absorptive power of the oxides of aluminium, magnesium and thorium vary with the temperature and wave-length. It is also shown that the absorptive power depends upon the average size of the grain of the powder. Aluminium oxide having a grain size of about 1 μ shows a distinct fall in its absorptive power in the red portion of the spectrum. W. C. S. P.

466. Method for Extending the Balmer Series. T. Takamine and T. Suga. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 265. *pp.* 117–122, *Sept.* 3, 1930. *In English.* Balmer lines of hydrogen are remarkably well developed when a condensed discharge is passed through a long neon tube containing a trace of hydrogen as impurity. The series could be followed up to H_{25} on a spectrogram having 6·4 Å./mm. dispersion with the exposure of a few hours. AUTHORS.

467. New Lines in the Arc and Spark Spectrum of Helium. P. G. Kruger. *Phys. Rev.* 36. *pp.* 855–859, *Sept.* 1, 1930.—The glow inside a Paschen hollow kathode was used as the light source. Carbon, tantalum and tungsten were used as the kathode materials. Helium gas for these experiments was specially refined, so that only very slight traces of neon could be detected. The spectra were photographed by two different gratings used alternately in a Sawyer vacuum spectrograph and in a grazing incidence vacuum spectrograph. The $1s^2S_{\frac{1}{2}} - np^2P_{\frac{1}{2}, 1\frac{1}{2}}$ series of HeII was extended to nine members, and the wave-lengths of the intensity maxima were calculated, so that these wave-lengths can be used for standards in this region. Lyman's line at 600·019 Å. has been found to be a He band. The forbidden line $1s^2\,{}^1S_0 - 1s2s\,{}^1S_0$ is present. Another line, thought to be $1s2s\,{}^1S_0 - 2s^2\,{}^1S_0$, has been observed. The line 320·392 Å., first observed by Compton and Boyce, is surely a helium line, and very probably the transition $1s2p^3P^o_{012} - 2p^2\,{}^3P_{012}$. The 303 series is by far the strongest series in the helium spectrum when pure helium is used in the discharge lamp. When, however, slight impurities of oxygen or carbon are introduced, the 584 series of HeI, as well as the 600·019 Å. band, is greatly enhanced, and the 303 series is weakened. The presence of the forbidden line $1s^2\,{}^1S_0 - 1s2s\,{}^1S_0$ is probably due to the fact that the levels concerned are metastable, and that the gas pressure in the discharge in the lamp was exceedingly low. AUTHOR.

468. Spectra of Carbon, Nitrogen and Oxygen, CIV, NV and OVI. B. Edlén and A. Ericson. *Zeits. f. Physik*, 64. 1–2. *pp.* 64–74, 1930.—From the results of an investigation with the vacuum spectrograph in the extreme ultra-violet by a method previously described [see Abstract 2192 (1930)], there is now given the series of doublet spectra similar to lithium of the elements C, N and O. For the ground term $2^2S_{\frac{1}{2}}$ the following values were obtained: CIV 520,220, NV 789,591 and OVI 1,114,206. They correspond to the ionisation potentials CIV 64,190 NV 97,428 and OVI 137,482 volts. In a table a comparison is given of the whole series LiI, BeII, BIII, CIV, NV and OVI. J. J. S.

469. Band Spectrum of Nitrogen. B. C. Mukherji. *Zeits. f. Physik*, 64. 9–10. *pp.* 698–707, 1930.—The spectrum was excited by a h.f. discharge corresponding to a wave-length of 300–500 m., and photographed with a large quartz spectrograph from 6700 Å. to 2813 Å. Some spectra are reproduced and observed values are tabulated. The relation of this spectrum to the afterglow in air and nitrogen is discussed. F. S.

470. Canal Ray and Electron Excitation of the Band Spectrum of Nitrogen. H. D. Smyth and E. G. F. Arnott. *Phys. Rev.* 36. *pp.* 1023–1033, *Sept.* 15, 1930.—The idea is suggested that the excitation of band spectra by canal ray impact on the one hand, and by electron impact on the other, may give quite different intensity distributions. The results of three groups of experiments on the band spectra of nitrogen are presented. In the first, the relative intensities of the lines in the 3914-negative band were studied. There seemed to be a small weakening of the lower rotational lines in the canal-ray excitation compared to electron excitation. In the second, the relative intensities of the second positive group and of the negative group were observed in a canal-ray beam. The intensities of the transitions from high initial vibrational states were abnormally great. The variations in comparison plates taken by us and by others with various sources were so great that no satisfactory standard of comparison could be chosen as representing excitations purely by electron impact. This suggested the third phase of the work, a study of the excitation by a beam of 700-volt electrons. This gave a most unusual distribution of intensity with nearly all the energy in the 0 → 0 and 0 → 1 bands of the negative group and a similar concentration in the second positive group. AUTHORS.

471. β and γ Bands of Nitric Oxide. R. Schmid, Theodora König and D. v. Farkas. *Zeits. f. Physik*, 64. 1–2. *pp.* 84–120, 1930.—Approximately 3000 lines in the γ and 1000 in the β bands of NO have been measured and systematised. The doublet separation of the $^2\pi_1$ level is expressed as a function of the rotation and vibration states. F. J. W.

472. Spectroscopic Researches Relating to Nitric Oxide and Nitrogen. M. Lambrey. *Ann. de Physique*, 14. *pp.* 95–183, *Sept.*, 1930.—The γ absorption bands of nitric oxide are found to be expressible by the equation $\nu = \begin{bmatrix} 44{,}079 \\ 44{,}201 \end{bmatrix} + n'(2349\cdot 5 - 11\cdot 5n') - n''(1888 - 13\cdot 8n'')$, in place of that proposed by Guillery. The components $^2s - {}^2p_1$ of the (0, 0) and (0, 1) bands of the γ system confirm the value of the constant b deduced from Guillery's results but do not agree with that found by Schmid, Jenkins, Barton and Mulliken. The ultra-violet absorption spectrum of nitrogen peroxide is composed of two large bands attributable to N_2O_4 and complex bands associated with NO_2 molecules. The effect of impurities upon the absorption spectrum of nitric oxide is discussed. [See also Abstracts 2161 and 2826 (1930).] J. S. G. T.

473. Spectroscopy of Auroral Green-Line Radiation. J. C. McLennan and H. J. C. Ireton. *Roy. Soc., Proc.* 129. *pp.* 31–43, *Sept.* 3, 1930.—A spectrograph specially designed for this work is described, embodying a camera lens working at F/1, but a collimator of long focus (F/10) in order to obviate interference by the slit jaws. Three camera lenses have been used and compared—a compound lens by Ross, and two specially corrected single lenses by Mellish and Hilger respectively. The Mellish lens gave least dispersion and the Ross the least speed coupled with best definition. The fastest lens is the Hilger. A special form of tube for producing the green amoral line in a mixture of argon and oxygen is also described, and a suggestion as to the origin of the line put forward. F. S.

474. Spectra of Solid Gases. L. Vegard. *Ann. d. Physik*, 6. 4. *pp.* 487–544, *Sept.* 4, 1930.—Study of the auroral light has led to that of the spectra of solid gases. During several years, observations of many hundred new lines have been made, and a very considerable number have been arranged in series. The present paper is a *résumé* of this work and deals principally with the spectra of nitrogen, alone or mixed with argon or neon, when examined at the temperature of either liquid hydrogen or helium. Chapters are given dealing with the theory of band spectra, observed series and determinations of term values, intensity distribution in series, and electron terms in series belonging to the solid state. A Bibliography is appended. F. S.

475. Spark Spectrum of Neon. S. Frisch. *Zeits. f. Physik*, 64. 7–8. *pp.* 499–501, 1930.—The spectrum has been measured with an accuracy of about 0·03 Å. from 1500 to 2200 Å. by means of a vacuum spectrograph with a 1-m. concave grating, giving a dispersion in the first order of 16·5 Å. per mm. The source was a neon tube with hollow kathode. The energy levels concerned in the production of most of the lines are identified. J. H. A.

476. First Spark Spectrum of Xenon. P. K. Kichlu. *Zeits. f. Physik*, 64. 9–10. *p.* 697, 1930.—A number of lines of constant difference of about 10,500 are listed, observed in the published values of Gremmer. [See Abstract 2185 (1930).] F. S.

477. Spectrum of Xenon in the Far Ultra-Violet (2700–1850 Å). G. Déjardin. *Ann. de Physique*, 14. *pp.* 82–93, *July–Aug.*, 1930.—The spectrum was excited in an electrodeless silica tube, and determined as previously described. Between the limits 2735–1872 Å., 544 lines have been measured with an accuracy of 0·05–0·1 Å., and their intensities recorded. Of these, 312 are referred to XeII, 35 to XeIII, 192 to XeIV, and 5 to both XeII and XeIV, some, however, doubtfully. The XeIII spectrum, which begins abruptly towards the end of the visible spectrum, appears to end as abruptly below 2500 Å. Agreement is good as regards lines also measured by Baly. [See also Abstract 2824 (1930).] C. A. S.

478. Continuous and Band Spectra of Mercury and Zinc Vapours. H. Volkringer. *Ann. de Physique*, 14. *pp.* 15–81, *July–Aug.*, 1930.—A connected account of work already published in fragments [see Abstracts 1761 and 2719 (1927), 3029 (1928), 1870 (1929) and 1869 (1930)] illustrated by registered curves, intensity diagrams, and photographs of spectra. It was further observed that the electrodeless silica tubes, when heated to about 400° C., exhibited phosphorescence lasting some 15 min. after cessation of the discharge. This varies with the pressure and temperature, but is independent of the nature of the contents of the tube. It is concluded that it is due to a species of kathodic bombardment of the walls of the tube by the electrons and ions of the excited gas. There is also some indication of phosphorescence of that gas itself, but lasting only about 1 sec. after the discharge ceases. The blackening that occurs in such a tube after long use was noticed to be more intense along a helicoidal line coinciding with the line of the wire wound round it, or of the interval between adjacent coils. C. A. S.

479. Variations of Relative Intensities in the Resonance Spectrum of Selenium. L. Natanson. *Comptes Rendus*, 191. *pp.* 294–296, *Aug.* 11, 1930.—In the resonance spectrum of selenium vapour at 600° C., excited by the mercury line 4047 Å. at pressures of either 4 mm. or 35 mm. of mercury, the author finds that the intensity of the components of longer wave-length of the several doublets in the spectrum increases relatively to that of the remaining components, with increase of pressure, although, in certain cases, the absorption of the vapour tends to decrease. In general, the effect is much less pronounced than that found in the case of sulphur vapour [see Abstract 3143 (1930)]. J. S. G. T.

480. Resonance Radiation of Manganese Vapour. J. Fridrichson. *Zeits. f. Physik*, 64. 1–2. *pp.* 43–47, 1930.—Investigation was made of the fluorescence in saturated Mn vapour at temperatures of about 700° to 900° C., excited with Mn sparks, and the triplets 1S — 2P and 1S — 2P′ of the Mn spectrum were found corresponding to two resonance lines. With increasing temperature (greater vapour tension) the intensity of the triplet 1S — 2P′ became much stronger, while at low temperatures only the triplet 1S — 2P appeared. The resonance lines occurring confirm the series analysis of the Mn spectrum of Catalan and indicate again that the ground-level condition of the Mn atom is a 1S level. J. J. S.

481. Terms of the Arc and Spark Spectra of Chromium. C. C. Kiess. *Bureau of Standards, J. of Research*, 5. *pp.* 775–779, *Sept.*, 1930.—Tables of terms are presented for the arc and first spark spectra of chromium. Babcock's unpublished Zeeman effects have aided in establishing many of them. Combinations of these terms account for nearly all the stronger lines of CrI and CrII. All the terms which have been identified conform to the requirements of Hund's theory. AUTHOR.

482. Spectrum of Explosive Lithium Wire. L. Eckstein and I. M. Freeman. *Zeits. f. Physik*, 64. 7–8. *pp.* 547–555, 1930.—The inaccessible combinations $1s - md (m = 3, 4, 5)$ have now been determined from the lithium explosion spectrum by means of electrically-pulverised lithium wire. The spectrum is relatively simple, whilst lithium is more easily obtained in wire form than the other alkalies and hence the most convenient for such spectral study. H. H. Ho.

483. Spectrum of Thallium III. J. C. McLennan and Elizabeth J. Allin. *Roy. Soc., Proc.* 129. *pp.* 43–47, *Sept.* 3, 1930.—The structure of a number of visible thallium lines excited in a quartz discharge tube were analysed by a large glass transmission echelon grating. The observed fine structures are tabulated and a term scheme given. F. S.

484. Intensity Measurement in the Copper Arc. L. S. Ornstein and D. Vermeulen. *Zeits. f. Physik*, 64. 9–10. *pp.* 657–659, 1930.—The intensity relation of the $1^2S - 2^2P_1$ and $1^2S - 2^2P_2$ lines in the copper arc spectrum was measured as function of the current strength. Thereby it is shown that the picture that W. B. Nottingham has given of the mechanism of excitation of the copper arc spectrum cannot be correct [see Abstract 2555 (1929).] The doublet relation does not obey the summation rule. J. J. S.

485. Intensity of the Blue Cæsium Doublet. W. Schütz. *Zeits. f. Physik*, 64. 9–10. *pp.* 682–696, 1930.—The total absorption considering the Doppler effect in dependence on the number of the dispersion electrons on the path of the light ray was ascertained. Noteworthy is the newly disclosed transition region between the ranges of validity of the two boundary laws given by Ladenberg and Reiche for very weak and strong absorption. In this transition region the total absorption is practically independent of the number of dispersion electrons. The method used did not prove suitable, as at first intended, for determining the proportionate number of the dispersion electrons responsible for the blue doublet out of the total absorption in pure cæsium vapour; but from the magneto-rotation there was found as provisional result a probable lower limiting value of 3·6. J. J. S.

486. Intensity of Doublet Lines and Dirac's Theory. K. Bechert. *Ann. d. Physik*, 6. 6. *pp.* 700–720, *Sept.* 25, 1930.—A mathematical paper in which an expression for intensity is obtained from Dirac's equation. The results obtained show some discrepancies from observed values. F. S.

487. Appearance of "Forbidden Lines" in Spectra. L. D. Huff and W. V. Houston. *Phys. Rev.* 36. *pp.* 842–846, *Sept.* 1, 1930.—A rough calculation shows that the quadrupole term in the radiation of a forbidden line is usually larger than the dipole produced by an external electric field. This is not true, however, when there is an intermediate state, with which both initial and final states combine, and which lies close to one of them. If the J selection rule is violated, and the Laporte rule is obeyed, the radiation cannot be due to the quadrupole term and must be ascribed to the octopole. Hg 2270 is such a line. An octopole transition will have a Zeeman effect distinctively different from that of a dipole or quadrupole. AUTHORS.

488. Hyperfine Structure of the LiII Spectrum. P. Güttinger. *Zeits. f. Physik*, 64. 11–12. *pp.* 749–759, 1930.—Studies the theory of the hyperfine structure of lithium spectra and shows that the structure of the line ($2s - 2p$) of ortho Li^+ (spark or LiII spectrum) measured by Schuler can be explained by using the value $i = 3/2(Xh/2\pi)$, deduced by Jenkins for the impulse moment of the Li nucleus from the intensities of the Li_2 bands. Two graphs showing the relative intensities of the component lines as determined experimentally by Schuler, and as calculated by the theory. show fairly satisfactory agreement. H. N. A.

489. Hyperfine Structure of Lines in the Arc and First Spectrum of Indium. J. C. McLennan and Elizabeth J. Allin. *Roy. Soc., Proc.* 129. *pp.* 208–211, Sept. 3, 1930.—A table contains λ in Å., ν and intensity for nine lines, which have been identified as belonging to the spectrum of indium II; only three had previously been identified. These nine lines are the strongest ones of the multiplet $^3D^1D \rightarrow {}^3F^{0\,1}F^0$, and a table shows their term relationships. Another table shows the structure of these lines, and of the arc lines 4511 Å. and 4102 Å. All the lines have either two or three components, which suggests that the moment of momentum of the nucleus is $\frac{1}{2}h/2\pi$; certain reasons for doubting the accuracy of this value are given. H. N. A.

490. Hyperfine Structures of Some Cadmium Lines and the Hypothesis of Nuclear Spin. C. L. Albright. *Phys. Rev.* 36. *pp.* 847–854, *Sept.* 1, 1930.—Measurements have been made of the hyperfine structures of the Cd lines $\lambda\lambda$5086, 4800, 4678, 3614, 3613, 3610, 3468, 3466, 3404, and 6438 Å. ($2^3P_{2,1,0} - 3^3S_1$, $2^3P_2 - 3^3D_{1,2,3}$, $2^3P_1 - 3^3D_{1,2,3}$,

$2^3P_0 - 3^3D_1$, and $2^1P_1 - 3^1D_2$) using two quartz Lummer Gehrcke plates. The results are compared with those of MacNair and Schrammen, with fair agreement in general. **λλ3613** and **3466** Å. are single in agreement with Schrammen. Structure ascribed to **λ3466** Å. by MacNair and to **λ3613** Å. by Wali-Mohammad belongs to **λλ3468** and **3614** Å. respectively. An attempt is made to extend the application of the hypotheses of Schüler and Brück to the $^3P - ^3D$ lines. This succeeds fairly well save in the cases of **λλ3466** and **6438**, both of which are single, whereas if the ideas of Schüler and Brück are accepted they apparently should show readily resolvable fine structure. It is also pointed out that the hypotheses of the above authors would require incomplete polarisation of the $1^1S_0 - 2^3P_1$ resonance line in contrast to the observed value of 100 %. AUTHOR.

491. Structure of Emission Lines. F. Hoyt. *Phys. Rev.* **36.** *pp.* 860–870, *Sept.* 1, 1930.—A method for obtaining the intensity distribution in a spectral line is derived from Dirac's quantum theory of the radiation field. The calculations are carried out for the case of emission from a first excited state (resonance line) and show that the intensity of frequency ν is, in this case, proportional to $1/[4\pi^2(\nu_0 - \nu)^2 + (A \cdot 2)^2]$, where A is the rate at which atoms are leaving the upper state and ν_0 is the frequency of the transition. The half-width is therefore $1/2\pi$ times the Einstein probability coefficient for spontaneous transition to the lower state. The more general case where the lower state has a finite lifetime is not treated. A general method for the treatment of radiation problems, which is essentially Weyl's modification of Dirac's method, is briefly described. AUTHOR.

492. Frequency Shifts in Dispersing Media. G. Breit and E. O. Salant. *Phys. Rev.* 36. *pp.* 871–876, *Sept.* 1, 1930.—The propagation of a light wave through a dispersing medium is discussed. The absorption frequencies of the medium are shown to be those of the coupled system formed by molecules contained in a cavity elongated in the direction of the electric intensity of the incident wave. The cavity is supposed to contain a large number of molecules and yet to be small compared to the wave-length. The absorption bands of the coupled system are discussed. For tenuous media the shift is small and of the order of the Lorentz-Lorenz shift. The modification introduced by the quantum theory consists in replacing the classical $e^2/8\pi^2 m\nu$ by $|x(I, II)|^2$, where $x(I, II)$ is the unperturbed matrix element of the polarisation in the fixed direction X, the normal state is I, the excited state II. In this approximation the shift is obtained by replacing the classical e by Dennison's effective charge. For regular arrangements of molecules, no broadening due to coupling is expected. For dense media there are additional effects even to the first order. These are: (1) the electrostatic interaction of a molecule with its neighbours due to its excitation, (2) the effect of the finite space extension of the $u_I^* u_{II}$ charge distribution. A comparison of the measured shifts in liquid HCl and HBr with the extrapolation of the Lorentz-Lorenz formula modified by $|x(I, II)|^2$ is made. The observed shift is much too large to be explained without taking into account effects (1), (2). Particle exchange has been neglected. AUTHORS.

493. Axiality of Light Emission and Atomic Structure. Parts VIII and IX. J. Stark. *Ann. d. Physik*, **6.** 5. *pp.* 637–680, *Sept.* 17, 1930.—In continuation of previous work [see Abstract 2835 (1930)], the question of axiality of intensity and polarisation of light from atoms arranged in a definite way is considered. The choice of a suitable crystal is discussed, and then experiments with reflected X-rays are described. Among other conclusions it is found that there is a greater intensity of K radiation reflected parallel to the needle axis of dibrom-anthracene needle crystals. Observations on dibrom-benzol are also described. Part IX is a discussion of the axiality of valence fields of carbon and nitrogen atoms in chemical compounds, and includes a criticism of Sommerfeld's theorems of the spherical-symmetrical structure of chemical atoms. F. S.

494. Apparatus for Raman Effect in Organic Compounds. S. Ziemecki. *Acad. Polonaise Sci. et Lettres, Bull.* 6–7.*A*. *pp*. 309–317, *June–July*, 1930. *In German.*—An apparatus is described the purpose of which is to allow of the scattering of light by liquids kept at a sufficiently constant high temperature. It consists of a scattering vessel of the Wood type (L shaped), held in an iron vessel provided with glass windows, containing paraffin, and heated by an electric heater on which it stands. Light is converged from each side on the liquid by condensing lenses. The apparatus is good for temperatures up to 250° C. A. C. M.

495. Raman Effect and Its Significance in Physics and Chemistry. S. Bhagavantam. *Indian Journ. Phys.* 5. *pp*. 237–307, *Sept.* 15, 1930.—A summary of the subject occupies eighteen pages, the remainder is devoted to an indexed bibliography, covering work published up to the autumn of 1930. An index of important substances and an author index are included. A. C. M.

496. Polarisation of Raman Radiation and Crystal Structure. F. Matossi. *Zeits. f. Physik*, 64. 1–2. *pp*. 34–38, 1930.—Polarisation of the Raman lines scattered in crystals of calcite and of sodium nitrate at different orientations has been observed by Aderhold. The experimental results are here reviewed, in relation to the structure of the CO_3 and NO_3 groups. It is shown that the states of polarisation of the lines due to calcite fit in with an isosceles triangle configuration for the CO_3 group. A. C. M.

497. Raman Effect and Molecular Constitution. B. Trumpy. *Zeits. f. Physik*, 64. 11–12. *pp*. 777–780, 1930.—The Raman effects shown by certain cis- and trans-isomers, *viz.* aqueous solutions of the sodium salts of fumaric and maleic acids, and of mesaconic and citraconic acids are investigated. Certain characteristic frequencies revealed by the Raman effect are common to cis- and trans-forms, whilst other frequencies are found only in one form. The frequency, about 1650 cm.$^{-1}$, common to the Raman effect shown by all the salts, and which is probably attributable to the C=O bond, is more marked in the case of the trans- than in the cis-compounds. J. S. G. T.

498. Raman Effect in Solutions of Mercuric Chloride and Bromide. H. Braune and G. Engelbrecht. *Zeits. f. phys. Chem.* 10. *Abt. B*. 1. *pp*. 1–6, *Sept.*, 1930.—$HgCl_2$ dissolved in water gives a strong line at 320 cm.$^{-1}$, and in acetic ester at 332 cm.$^{-1}$. $HgBr_2$ dissolved in acetic ester gives a line at 205 cm.$^{-1}$. Halides of cadmium gave no lines. The above frequencies are compared together and also with the inactive vibration 1280 cm.$^{-1}$ of CO_2, and it is shown that they are of the right order. A. C. M.

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499. Spectroscopy and Molecular Structure. *Zeits. f. Elektrochem.*, 36. *pp.* 581–645, *Sept.*, 1930.—A symposium on the subject held at the meetings of the Deut. Bunsen-Gesellschaft, Heidelberg, May–June, 1930, consisting of the following thirteen papers, together with discussions by various contributors: " Determination of Thermochemical Magnitudes from Spectroscopic Data," by **J. Franck**; " Experimental Results and Scope of Research in Band Spectra," by **R. Mecke**; " Methods of Interpretation and Prediction of Molecular Spectra," by **F. Hund**; " Structure and Spectra of Hydrogen and Helium Molecules," by **W. Weizel**; " Electronic States and Chemical Linkages in Diatomic Molecules," by **R. S. Mulliken**; " Relationship between Chemical Constitution and K-Absorption Spectra," by **O. Stelling**; " X-Ray Interference Determination of the Structure of Single Molecules," by **P. Debye**; " Infra-Red Spectroscopy," by **M. Czerny**; " Raman Effect and Molecular Structure," by **A. Smekal**; " Permitted and Forbidden Quantum Transitions," by **R. Ladenburg**; " Effective Cross-Section and Molecular Structure," by **C. Ramsauer**; " Quantum Theory of Homopolar Linkage," by **W. Heitler**; " Quantum Theory of the Double Bond and Its Stereochemical Behaviour," by **E. Hückel**. A. C. M.

500. Zeeman Effects for Thallium Spectral Lines. J. C. McLennan and A. M. I. A. W. Durnford. *Roy. Soc., Proc.* 129. *pp.* 48–70, *Sept.* 3, 1930.—The apparatus used was the same as in the work on tantalum [see Abstract 501 (1929)] with some improvements in technique. The theoretically expected and experimentally observed effects are tabulated, the observed patterns being also reproduced. Back and Goudsmit's suggestion as to the introduction of a new quantum number 1 is discussed. F. S.

501. Stark Components in Helium. G. O. Langstroth. *Roy. Soc., Proc.* 129. *pp.* 70–91, *Sept.* 3, 1930.—Displacements and intensities of various helium lines have been calculated by Foster [see Abstract 929 1928)], but the intensities previously observed have shown discrepancies. Measurements with higher fields are here recorded on the 2P – 4Q(λ4922) and 2P – 5Q(λ4388) lines of parhelium, and the 2*p* – 4*q*(λ4471) and 2*p* — 5*q*(λ4026) groups of orthohelium. The photographic-photometric method described by Dorgelo was used, the instruments being a 6-prism spectrograph and Moll microphotometer. Tables are given comparing calculated and observed values. There are definite discrepancies of two types, (*a*) in which all components vary, and (*b*) in which certain ones only vary. The former receive a qualitative explanation. F. S.

502. Calculation of Stark Effect. K. Basu. *Zeits. f. Physik*, 64. 9–10. *pp.* 708–713, 1930.—A mathematical paper giving the application of infinite determinants to the calculation of eigenvalues in the case of the Stark effect. F. S.

503. Stark Effect of Aluminium and Carbon. Y. Ishida and M. Fukushima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 266. *pp.* 123–143, *Sept.* 15, 1930.—The apparatus was the same as formerly used [see Abstract 3128 (1930)]. Some lines due to each element were observed in work on helium and neon, and others have now been studied so as to give data on lines due to these elements as impurities in other spectra and as a field indicator in the ultra-violet. The results are tabulated and discussed, and some spectra are reproduced. F. S.

504. Stark Effect on the Mercury Resonance Line, and its Behaviour in Magnetic Fields. P. Brazdziunas. *Ann. d. Physik*, 6. 6. *pp.* 739–771, *Sept.* 25, 1930.—Describes a method for the direct indication of the electrical division of the mercury line 2536·7. Å. The results show that a displacement towards the red of $5 \cdot 4 \times 10^{-4}$ Å. occurs when the σ components are acted upon by an electric field of 100,000 volts/cm. strength. The π component is also displaced by an amount equal to $1 \cdot 9 \times 10^{-4}$ Å. when acted upon by a 140,000 volt/cm. electric field, the displacement probably being towards the red. Further, the value of the electrical division of this mercury resonance line is shown to be proportional to the fourth power of the field strength. For superimposed and opposed parallel magnetic and electric fields no simple algebraically additive field effects could be observed, for certain magnetic fields there being complete extinction of the Stark effect. Polarised excitation of the σ and π components indicated this conclusively. Quantitative measurements of the polarisation power for the mercury resonance radiation in electric fields are given, it being shown that this power is 0·82 with a field strength of 140,000 volts/cm. and a mercury vapour pressure of 4×10^{-5} mm. No definite conclusions can be drawn from these measurements as to the behaviour of the hyperfine components in electric fields. Finally, with crossed magnetic and electric fields no appreciable effect on the Stark effect division is obtained for a definite magnetic field strength. R. C. F.

505. Residual Rays of Univalent and Divalent Fluorides. O. Reinkober and M. Bluth. *Ann. d. Physik*, 6. 6. *pp.* 785–792, *Sept.* 25, 1930.—The method used was the original Rubens method in which the radiation from a Nernst burner is reflected at three surfaces of the substance under test. The salts used were powdered and pressed into the form of plates. The mean results obtained were as follows: NaF, 35·8 μ; TlF, 48·6 μ; SrF_2, 40·7 μ; BaF_2, 50·7 μ, the wave-length of the residual ray being given in each case. [See also Abstract 1174 (1928).] W. S. S.

506. Theory of Elementary Light Quanta. E. Klein. *Zeits. f. Physik*, 64. 5–6. *pp.* 431–438, 1930.—Assumes the existence of only one kind of light quanta for all frequencies, the colour of the light being determined by the number of quanta emitted per second. Gives on this assumption a reasonable explanation of reflection, interference, the Doppler effect and the Compton effect, but is not quite so successful with regard to refraction. E. E. F. d'A.

507. Application of Integral Equations to Refraction and Specific Oscillations in the Electromagnetic Theory of Light. W. Sternberg. *Zeits. f. Physik*, 64. 9–10. *pp.* 638–649, 1930.—The integral equations developed by the author in a contemporary paper appearing in the *Math. Ann.* are here applied to discuss the refraction of electromagnetic waves by an infinitely long cylinder of any form of cross-section, and of specified dielectric constant and electrical conductivity. Approximate solutions of the integral equations are derived in a form suitable for numerical calculation. J. S. G. T.

508. Contemporary Theories of Light. W. F. G. Swann. *J.O.S.A.* 20. *pp.* 484–523, *Sept.*, 1930.—An address before the Optical Society of America at the Thomas Young Memorial Meeting at Cornell University in 1929. The development of the wave-mechanics theory of

Schrödinger from the Maxwell-Lorentz and earlier quantum theories and the matrix theory of Born, Heisenberg and Jordan are discussed. Some reference is made to the more philosophical aspects of the new theory.

C. B. A.

509. X-Ray Absorption in Gases. J. A. Crowther and L. H. H. Orton. *Phil. Mag.* 10. *pp.* 329–342, *Aug.*, 1930.—Measurements were made of the coefficient of absorption of CuK_a-radiation in air, carbon dioxide, nitrogen, oxygen, ethylene and hydrogen sulphide and of the ionisation (relative to that in air) produced in these gases by a beam of constant intensity. The calculated values of the total ionisation produced by the complete absorption of the radiation approximate closely to the values obtained for the relative ionisation produced by the total absorption of α-radiation. The average energy expended by X-rays in producing a pair of ions in the gas is found to be approximately proportional to the minimum ionisation potential of the gas for oxygen, carbon dioxide, ethylene and hydrogen sulphide, but is about 15 % smaller for nitrogen. The fraction of the absorbed X-ray energy utilised in producing ionisation is approximately constant for the majority of gases studied, but is about 15% greater for nitrogen.

W. H. Ge.

510. Fine Structure in the X-Ray Absorption Spectra of the K Series of the Elements Calcium to Gallium. B. Kievit and G. A. Lindsay. *Phys. Rev.* 36. *pp.* 648–664, *Aug.* 15, 1930.—The K X-ray absorption spectra of the free elements Ca, Cr, Mn, Co, Ni, Cu and Zn have been photographed and for each of these elements an extended fine structure has been obtained. The fine structure, consisting of six or seven secondary edges, extends over an energy range of more than 200 volts. In every instance the element was used as the absorbing screen except Mn where it was present in the alloy manganin. No detectable difference was found in the absorption spectrum of copper between that obtained with a brass screen and that with the element alone. An attempt was made to show more definitely the relation of the $K\beta_2$ emission line to the principal K absorption limit for Fe, Co, Ni and Cu. Indications are that the main edge is produced by the ejection of a K electron to an optical level rather than to infinity. It is shown that the Kossel theory alone is quite inadequate to explain all the secondary edges. On the basis of multiple ionisation the probable electron transitions have been determined and tabulated to account for the observed separations of the various secondary edges from the principal K edge. The methods employed herein to account for probable electron transitions, when applied to the transition proposed by Ray [see Abstract 213 (1930)], in his treatment of the fine structure in K and Ca, give very different energy values from those which he has computed.

Authors.

511. Absorption Measurements of X-Ray General Radiation. L. S. Taylor. *Bureau of Standards, J. of Research*, 5. *pp.* 517–538, *Sept.*, 1930.—Studied as a means for indicating the quality of the radiation, copper absorption curves for heterogeneous X-rays were obtained, using a standard and two thimble ionisation chambers. With the standard air chamber, logarithmic absorption curves were not found to become straight for filters up to 3 mm. in thickness—indicating a gradual elimination of the longer wave-lengths. With thimble chambers, owing presumably to errors from the chamber " wall effect," the curves were nonlinear only up to 1 mm. thickness of filter. Half-value layers and effective wave-lengths derived from the three sets of results were compared. The " effective wave-length " as derived from the slope of the absorption curve and the " half-value layer " are about equally sensitive to changes in quality at least up to 3 mm. thickness of filter. As should be expected, effective wave-lengths thus obtained are always longer than those obtained by Duane's finite filter method and, being less dependent upon the particular instrument used in the measurements, are, therefore, more consistent. On the basis of the effective wave-length determinations it is found that, contrary to the accepted views, the greater part of the highly filtered energy is not concentrated in the tungsten K lines. AUTHOR.

512. Classical Quantum Theory and X-Ray Excitation by Canal Rays and α-Particles. W. Band. *Phys. Soc., Proc.* 42. *pp.* 541–546, *Aug.* 15, 1930.—This paper shows, by application of the classical quantum theory and simple equations of energy, that it is not possible for canal rays of normal experimental energy to remove K-electrons from the atoms of a metal target either by capture or by simple removal into free space. No particular mechanism is assumed, but a safe maximum for the possible transfer of momentum to the ejected electron is taken to be the transfer which takes place in a head-on collision, electric attraction being neglected. The fact that α-particles are observed to excite X-rays shows that the mechanism must be almost as efficient as this. The process of capture is shown to be no more probable than that of simple removal into free space. The minimum energy for canal rays and the minimum velocity for α-particles, for K-radiation from copper, are calculated as at least 72 million volts and $1 \cdot 7 \times 10^6$ cm./sec. respectively. The theory claims to give a satisfactory explanation of all the experimental data so far available.

AUTHOR.

513. Total Reflection of X-Rays. E. Nähring. *Phys. Zeits.* 31. *pp.* 799–801, *Sept.* 1, 1930.—The easiest method for determining the refractive index of X-rays is that of total reflection. Various formulæ expressing the phenomena of total reflection of X-rays have been given, but hitherto no quantitative proof has been afforded how far these formulæ agree with experiment. A specially simple formula has been found by F. Jentzsch, and the author has verified this by observations on X-rays reflected from a silver mirror. The calculated reflection curve agrees with that obtained experimentally. J. J. S.

514. Reflection of Monochromatic X-Rays from Crystals. Y. Sakisaka. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 189–202, *Sept.*, 1930. *In English.*—The effect of surface treatment, such as grinding, has been investigated in so far as it influences the reflection of X-rays by crystals such as calcite, quartz, topaz, sodium chlorate, sulphur, iron pyrites and zinc blende. The results show that the crystals can be divided into three types: in the first, primary extinction operates almost entirely (*e.g.*, quartz); in the second, secondary (*e.g.*, calcite); while in the third, the effects of both extinctions are very small (*e.g.*, sulphur). F. J. W.

515. Double Crystal Study of Scattered X-Rays. J. A. Bearden. *Phys. Rev.* 36. *pp.* 791–798, *Sept.* 1, 1930.—A study of the unmodified scattered X-rays has been made to detect possible fine structure lines as reported by previous experimenters. With copper and silver K series scattered by blocks of graphite and aluminium no trace of any fine structure lines was observed. The sensitivity of the apparatus was apparently many times that used by any previous experimenter. Experiments were also performed to measure the change in wave-length and the width of the modified line. It was found that the change in wave-length agreed within 1 % with the change predicted by the quantum theory of X-rays scattered by free electrons. That is, with the equation $\delta\lambda = (h/mc)(1 - \cos\phi)$. The width of the modified line was found to be about twice as broad as it should have been from the divergence of the scattering angle. AUTHOR.

516. Analysis of Scattered X-Rays with the Double Crystal Spectrometer. N. S. Gingrich. *Phys. Rev.* 36. *pp.* 1050–1059, *Sept.* 15, 1930.—X-rays from a molybdenum target were scattered by graphite at approximately 109° and 161°. The scattered rays were analysed with a double crystal spectrometer. When scattering at 109° was used, no indication of the fine structure lines, reported by Davis and his collaborators [see Abstracts 516 (1929) and 220 (1930)], could be found. When scattering at 161° was used, the modified $K\alpha_1$ and $K\alpha_2$ lines were definitely separated. The value of $\delta\lambda$ was $0 \cdot 04721 \pm 0 \cdot 00003$ Å., the value of $(1 - \cos\phi)$ was $1 \cdot 9479$ and the calculated value of h/mc was $0 \cdot 02424 \pm 0 \cdot 00004$ Å. AUTHOR.

517. Determination of the Internal Structure of Liquids by X-Rays. P. Debye and H. Menke. *Phys. Zeits.* 31. *pp.* 797–798, *Sept.* 1, 1930. *Paper read before the Deut. Phys. Gesell., Halle, June*, 1930.—A preliminary account is given of experiments on the scattering which occurs in liquids when they are exposed to X-rays, with the object of deducing from these observations the internal structure of the liquids. Mercury was first examined and a kind of quasi-crystalline structure was found to exist in it. J. J. S.

518. Influence of Temperature on X-Ray Diffraction in Liquids. S. Tanaka and A. Tsuji. *Kyoto Coll. Sci., Mem.* 13. *pp.* 337–342, *Sept.*, 1930. *In English.*—The influence of temperature on the X-ray diffraction in seven liquids was studied by the photographic method. The camera with a long, narrow slit was attached by the heating and cooling device specially designed. Four effects were commonly recognised, though they were characteristic for each liquid; *i.e.*, (1) contraction of the position of the diffraction band, (2) broadening of the band and diffuseness of edges, (3) increase in the inner scattering, (4) decrease in the intensity of the diffracted X-rays. AUTHORS.

519. Interference Measurements on the Carbon Tetrabromide Molecule. E. Rumpf. *Phys. Zeits.* 31. *pp.* 791–792, *Sept.* 1, 1930.—In attempting to obtain X-ray diffraction patterns by the Debye-Scherrer method, for CBr_4 no satisfactory results could be reached using the vapour, owing to the close proximity of the boiling-point temperature (190° C.) and the temperature (210° C.) at which marked decomposition sets in. By working with a solution of the CBr_4 in benzene at a concentration corresponding to a gas pressure of 11 atmospheres, a diagram was obtained using copper K-radiation, in which a ring at $\theta = 27 \cdot 5°$ was identified as due to CBr_4. Using Debye's formula for the length of side of the CBr_4 tetrahedron, $\left(a = \frac{5}{8}\lambda \Big/ \sin\frac{\theta}{2}\right)$, the value $4 \cdot 0$ Å. units was computed, against $2 \cdot 99$ Å. units obtained by Debye for the corresponding magnitude in the CCl_4 molecule. W. S. S.

RADIOACTIVITY.

520. Relation Between the Disintegration Constant of Radio-elements Emitting α-Rays and Their Filiation Capacity. (Mme.) P. Curie and G. Fournier. *Comptes Rendus*, 191. *pp.* 326–329, *Aug.* 18, 1930. —From the equations $v = 0\cdot0818(100 - U)$ and $\log\lambda = -80 + 42\cdot5v$, where λ is the disintegration constant, is deduced the relation $\log\lambda = 268 - 3\cdot5\,U$. On plotting the $\log\lambda/U$ curve from experimental results for values of U between 75 and 85 the values of $\log\lambda$ lie approximately on the straight line defined by the equation $\log\lambda = 235 - 3\,U$ for many of the radioactive elements, the chief exceptions being AcC′ and U1. No explanation is suggested of the apparent relation.
C. A. S.

521. Computation of Age of Radioactive Mineral from Lead Content. A. F. Kovarik. *Am. J. Sci.* 20. *pp.* 81–100, *Aug.*, 1930.—The effect of the presence of ordinary lead (A.W. 207·20, and of non-radioactive origin) in a radioactive mineral on the calculation of its age is investigated, and the following approximate formulæ for the percentage amount (L) thereof, and the age (T) deduced on the assumption that radium and actinium are branch series from uranium II, both ending in an isotope of lead of A.W. 206; and $\lambda_U/\lambda_{Th} = 2\cdot85$:—

$$L = \frac{207\cdot2\,\mathrm{Pb}/A \times [2\cdot85 \times 208(A - 206) - (\mathrm{Th}/U) \times 206(208 - A)]}{[2\cdot85 \times 208 \times 1\cdot2 - (\mathrm{Th}/U) \times 206 \times 0\cdot8]}$$

and $T = (\mathrm{Pb}/A - L/207\cdot2)/(U + 0\cdot36\mathrm{Th}) \times 1\cdot567 \times 10^{12}$, where A is the atomic weight of the lead in the mineral, and Pb, U and Th the percentage amounts (by weight) of (all) lead, uranium and thorium in the mineral. The same formulæ are approximately correct (L then denoting the amount of actinium D + ordinary lead) if actinium D has A.W. 207 and originates from a separate isotope of uranium (actino-uranium). Calculated in this way the following ages (in millions of years) and percentages of ordinary lead (or ordinary lead + actinium D) are arrived at: uraninite (Flat Rock) 249, 1·244; thorite (Brevig) 225, 0·009; bröggerite (Raade) 911, 0·39; cleveite (Aust-Agder) 966, 1·44; cleveite (Slattersdalen) 978, 0·145; uraninite (Keystone) 1469, 0·66; uraninite (Sinyaya Pala) 1853, 0·89. **Errata,** *ibid.*, p. 393, Nov., 1930. C. A. S.

522. Actino-Uranium and the Ratio of Actinium to Uranium in Minerals. A. F. Kovarik. *Science*, 72. *pp.* 122–125, *Aug.* 1, 1930.—On the assumption that actinium descends from actino-uranium [see preceding Abstract] the amount of actinium D + ordinary lead in the bröggerite analysed by Fenner and Piggot [*Nature*, 123, 793 (1929)] is calculated as 0·986 %, of which 0·274–0·364 is ordinary lead and the rest actinium D; its age is deduced as 825×10^6 years. That actinium is thus descended is shown to be probable by the fact that the actinium-uranium ratio varies, being less in older minerals. The disintegration constant of actinium-uranium is about $2\cdot5 \times 10^{-9}$/year, and period $2\cdot7 \times 10^8$ years. C. A. S.

523. Mechanism of Precipitation of a Radium Preparation of High Emanating Power. O. Erbacher and H. Käding. *Zeits. f. phys. Chem.* 149. *Abt. A.* 6. *pp.* 439–448, *Sept.*, 1930.—A solution containing ferric and radium-barium chlorides [Fe : (Ra + Ba) = 75 : 1;

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Ra : Ba = 1 : 1] precipitated by a large excess (50 times) of ammonia containing 10 % of ammonium (*a*) carbonate, (*b*) sulphate or (*c*) chromate, gives after drying and storing in moist air a preparation possessing an emanating power, after the lapse of about a month, of about 100 % for (*a*) and (*b*) but only 65 % for (*c*). If the operation be carried out in two stages, *i.e.*, the mixture with ammonia poured into the ammonium salt solution, the result for (*a*) and (*b*) is the same, with (*c*) 77 %. It is suggested that the ferric hydroxide gel after formation undergoes a change in surface, which takes a small but appreciable time. Radium chromate, being very insoluble, precipitates before this is complete, and so remains partially embedded in the gel, the carbonate and sulphate separating out more slowly, are adsorbed entirely on the surface. This explanation is supported by results with ferric and aluminium chlorides with no addition of ammonium salt. It is further shown that in absence of such salt the radium is adsorbed as hydroxide. The diminution in emanating power on complete drying is attributed to crystallisation of the adsorbed radium salt, due to approximation of the particles thereof by reason of the shrinking of the gel on drying, this tendency being greater in the case of radium than of thorium. This hypothesis is supported by the fact that rapid desiccation of the gel (by alcohol and ether), so that contraction thereof is prevented, results in a dry preparation which can be stored dry without loss of emanating power. C. A. S.

524. Distribution of Radium Emanation between Liquid and Solid Phases with Water and Benzene. F. Witt. *Akad. Wiss. Wien, Ber.* 139. 2. *A.* 5–6. *pp.* 195–202, 1930.—Attempts to determine the solubility of radium emanation in solidified water or benzene show that only a small part of the original emanation content is present in the solid. The actual amount thus present depends on the velocity of solidification, but is practically independent of the temperature. When this velocity is very small the amount of emanation taken up by the solid phase is very small and increases strongly from about 10^{-3} (the velocity of solidification being taken as 1 when 1 c.c. of the solvent solidifies in 1 second). The emanation is, therefore, not absorbed but occluded in ice and other solidified substances, the quantity occluded depending principally on the number and size of the air inclusions in the solid material. With benzene, if the solidification is sufficiently slow, the occlusion may be depressed to zero but with water the lowest value attainable is 3–4 %, but this may be further diminished to zero if the water is solidified very slowly and free from bubbles. T. H. P.

525. Scintillating Power of Calcium Tungstate. Berta Karlik. *Akad. Wiss. Wien, Ber.* 139. 2. *A.* 7–8. *pp.* 319–326, 1930.—The brightness of α-ray luminescence of calcium tungstate is found to be proportional to the residual range of the α-particles, but reaches a saturation value with very small grains. This is in agreement with the results on zinc sulphide and diamond [see following Abstract]. Calcium tungstate shows, unlike other substances, very little fatigue under α-rays and the same is true for the effect of high pressure on it. The fatigue under γ-rays is of about the same order as with zinc sulphide, indicating that the luminescent mechanism is different for α-rays and γ-rays. J. E.

526. Luminescence of Zinc Sulphide and Diamond under Radioactive Radiations. Berta Karlik. *Akad. Wiss. Wien, Ber.* 139. 2. *A.* 7–8. *pp.* 509–519, 1930.—The curves obtained for the destruction of the luminescence of zinc sulphide by the α-rays of polonium differ from those of Marsden [see Abstract 76 (1911)] with the α-, β- and γ-rays from RaEm, the difference being attributed to the absence in the present case of γ-rays. It appears that the green and blue bands are affected differently. The quenching by γ-rays reaches a saturation value which is not explicable on the basis of a dark regeneration. Similar results were obtained with diamond. A linear relation was found between the brightness of α-ray luminescence and number of α-particles when these were of the order of 10^7 per sq. mm. per sec. [See also preceding Abstract.] J. E.

527. Compensation Electrometer for Radioactive Measurements in Buildings with Radioactive Infection. W. A. Sokolow. *Zeits. f. Physik*, 63. 5–6. *pp.* 318–321, 1930.—Describes an apparatus consisting of two chambers of exactly the same dimensions forming two ionisation chambers each having its own electrometer. The electrodes of the two chambers are connected by a thin wire, and the potential of one of them is kept at + 200 volts, and that of the other at − 200 volts. The result is that even in rooms that are strongly infected by radioactive matter, or through which γ-radiation from terrestrial or cosmic sources passes, equal and opposite currents are produced in the two chambers, and the total effect on the electrometers is zero. If, however, a radioactive substance giving out γ-rays is placed on the cover of one of the chambers, some of the rays pass into the interior, and the current through this chamber is increased, which upsets the balance, so that a measurement of the radioactivity of the substance can be made. Measurements can also be undertaken with α-rays, which are allowed to penetrate into one of the chambers through a mica window. H. N. A.

528. New Method of Analysis of Groups of α-Rays. E. Rutherford, F. A. B. Ward and C. E. Wynn-Williams. *Roy. Soc., Proc.* 129. *pp.* 211–234, *Sept.* 3, 1930.—Applications of the Greinacher type of counter for α-rays are described in which the ionisation current due to a particle is amplified linearly by means of thermionic valves, there being no ionisation by collision. This counter is valuable in studying complex beams such as the long-range α-particles from radium C and thorium C. Using this type of counter and a double ionisation chamber it is possible in complex beams for α-particles to record only those particles which stop within the chamber itself and not those which pass right across it, thus giving a measure of the number of particles with ranges between (x) mm. and $(x + 2)$ mm. With this differential counter the 8·6 cm. α-particles from thorium C′, the 7·0 cm. particles from radium C′ and the 3·9 cm. particles from polonium all appeared to be homogeneous groups. But the 5·5-cm. particles from actinium C were found to consist of two well-marked groups differing in range by 4·2 mm. The 4·8 cm. particles from thorium C were also found to be a complex group as in Rosenblum's results by the magnetic deflection method. The missing short-range α-particles emitted in the dual disintegration of radium C were found and their constants determined. These particles correspond to the transformation of radium C into radium C″ and are present to an extent of about 1 in 4000 of the main 7·0-cm. particles from radium C′, apparently consisting of two groups—the main one of range 4·1 cm. and a smaller one of range 3·9 cm. J. J. S.

529. Capture of Electrons by Swift α-Particles. J. C. Jacobsen. *Phil. Mag.* 10. *pp.* 401–412, *Sept.*, 1930.—The capture of electrons in hydrogen was investigated and experiments were also made with air. The apparatus used was similar to that of Rutherford's. The probability of capture in H is several times smaller than that in air. The method used to find the effect of pressure was the determination of the change in the number of scintillations with increasing pressure on a ZnS screen. It was found that within the experimental error the number of single-charged α-particles decreases exponentially with increasing pressure. In a particular case the value of the mean free path, $\bar{\lambda}_1$, of a singly charged α-particle in H at standard atmospheric pressure calculated by an application of the Thomson ionisation theory is $\bar{\lambda}_1 = 6 \cdot 5 \times 10^{-3}$ cm. The experimental value for $\bar{\lambda}_1$ was $6 \cdot 2 \times 10^{-3}$ cm. The results of the measurements for H and air are given in a diagram in which the abscissa is the actual mean free path and the ordinate the number of scintillations. J. J. S.

530. Photographic Counting of α-Particles. J. C. Jacobsen. *Phil. Mag.* 10. *pp.* 413–416, *Sept.*, 1930.—The conditions necessary to carry out photographic counting of α-particles were investigated. Quantitative work is possible with swift α-particles when the number lies between 10,000 and 200,000 per sq. mm. of the plate. J. J. S.

531. Photographic Action of α- and H-Particles. Marietta Blau. *Akad. Wiss. Wien, Ber.* 139. 2. A. 7–8. *pp.* 328–347, 1930.—Estimates photographically, using oblique incidence, the particle numbers and range distributions of α-particles emitted by ThC and H-particles released from paraffin. These results are also compared with those obtained from a tube electrometer when used with the same experimental conditions operative. The range distributions, estimated from the lengths of the lines of points, generally show a displacement towards the lower values, which is probably due to scattering in the emulsion. Results are given for two types of plates—Agfa "*Röntgenzahnfilm*" and Imperial "Process" plate—and both types give numbers of α-particles which agree with those obtained from the electrometer. The process plate also indicates for the H-particles a number which agrees, within the limits of experimental error, with that given by the electrometer, the other type only indicating half this number. The "*Röntgenzahnfilm*" also possesses another peculiarity in that only every other silver bromide grain is blackened by H-particles, whilst every grain is affected by the α-particles. This difference is not apparent in the process plates. [See also Abstracts 382 and 2423 (1928).] R. C. F.

532. Range Groups of H-Particles from Aluminium. H. Pose. *Zeits. f. Physik*, 64. 1–2. *pp.* 1–21, 1930.—By the method previously described [see Abstract 3587 (1929)] three range groups of H-particles were observed on disintegration of Al. In the present paper experiments are described with the object of ascertaining the primary energy necessary for exciting these separate range groups. It was found that two of these groups were produced only by a characteristic primary energy, whilst the third group was caused by both rapid and slow primary rays. This behaviour can be explained in terms of the new quantum theory of the atom nucleus, in the case of the two first groups as resonance effect between the de Broglie waves of the α-particle and a characteristic nucleus vibration, in the case of the third group as simple penetration of an α-particle into the nucleus. J. J. S.

533. Theory of Atom Disintegration. G. Beck. *Zeits. f. Physik*, 64. 1–2. *pp.* 22–33, 1930.—Two sorts of quantum processes are discussed which, according to the experimental results of Pose, are responsible for the disintegration of the nucleus of Al [see preceding Abstract]. In the first of these, at a certain definite energy of the incident α-ray, resonance occurs with a quantum condition of the nucleus. In the second the α-particle springs from its original condition into another condition of the continuous spectrum, and the difference of energy thus becoming free causes the emission of an H-particle. J. J. S.

534. Resonance and Damping in the Theory of the Atom Nucleus. R. d'E. Atkinson. *Zeits. f. Physik*, 64. 7–8. *pp.* 507–519, 1930.—It is shown that the behaviour of the simple model of a radioactive nucleus very accurately corresponds to a case of optical resonance, so that the natural damping (decay constant) can be calculated from the "line breadth" of the Schrödinger "obliterated proper values." The result agrees exactly with the formula of Fowler and Wilson, and so far differences in the model do not introduce changes; it also agrees with the formula of Atkinson and Houtermans. The influence of this resonance on the penetration probability is investigated, and a qualitative validity of Gamow's formula is found, whether only the resonance penetration or only the usual permeability or both actually are present. J. J. S.

535. Problems of Nuclear Physics Treated According to Wave Mechanics. A. C. Banerji. *Phil. Mag.* 10. *pp.* 450–464, *Sept.*, 1930.—It is assumed that γ-ray emission is due to change in energy-level of an α-particle or any charged positive particle describing quantum orbits in the nucleus. The α-particle moves in a field of potential energy $V = \frac{2e^2Z}{r}\left(1 - \frac{r_0}{r}\right)$, where r_0 is a constant of the order 10^{-13} cm. (the nuclear radius). Inserting this value of V in Schrödinger's equation $\nabla^2\Phi - \frac{8\pi^2M}{h^2} . V . \Phi - \frac{4\pi iM}{h}\frac{\partial\Phi}{\partial t} = 0$, two cases arise corresponding (*a*) to discrete quantised negative values of the energy, Φ put equal to $e^{\frac{2\pi i}{h}Et}$, and (*b*) to discrete quantised positive, Φ put equal to $e^{-\frac{\mu}{2}t} e^{\frac{2\pi i}{h}Et}$. Here E is the (*real*) energy eigenvalue and μ is another real constant the physical meaning of which is not explained. Case (*a*) yields negative energy-levels, transitions between which would correspond to γ-rays, 600 times harder than the K spectrum of the element and only comparable with cosmic rays. The negative energy values are therefore incapable of explaining ordinary γ-ray emission. Case (*b*) leads to positive α-particle energies, in general agreement with experimental values observed in radioactive emission, and such that differences between the energy-levels correspond to γ-rays of the right order of hardness. The theory is applied to the γ-ray spectra of radium B, radium C, thorium C + C′, mesothorium 2, radio-actinium, and actinium X, nuclear quantum numbers being chosen to fit the observed γ-ray frequencies. W. S. S.

536. β-Radiation and the Energy Principle. J. Kudar. *Zeits. f. Physik*, 64. 5–6. *pp.* 402–404, 1930.—Endeavours to reduce the difficulties connected with the continuous spectrum of the β-rays, the sharply defined β-disintegration constants, and the vanishing of the electron spin

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within the atomic nuclei, by assuming that the β-particle inside the nucleus has a sharply defined energy which is equal to the mean energy of the primary β-spectrum. In this way the principle of the conservation of energy is preserved at least statistically, though not for the individual nuclear processes. Studies the behaviour of RaE, for which the mean energy of disintegration is known, and arrives at a value of the energy breadth of the β-spectrum (ΔE) which agrees with the experimental value. H. N. A.

537. Absolute Intensities and Conversion Coefficients of the γ-Rays of Radium B and Radium C. C. D. Ellis and G. H. Aston. *Roy. Soc., Proc.* 129. *pp.* 180–207, *Sept.* 3, 1930.—A small thick-walled platinum tube was filled with radon, and the γ-rays from the RaB and RaC formed from the radon ejected photoelectrons from the platinum. The excited corpuscular spectrum was recorded on a photographic plate by the usual method of semicircular focussing. The walls of the tube were usually about 0·4 mm. thick to stop most of the primary β-particles from RaB and C. The natural spectrum of RaB and C was also photographed by exposing platinum wire to radon, the object of the experiments being to compare the intensities of the lines obtained from the two types of source for equal numbers of disintegrating atoms. From the results of the measurements the authors deduce the ratio of the internal conversion coefficients for different levels for certain of the γ-rays of RaB and RaC. The tables worked out go some way towards presenting a quantitative account of the events occurring in a radioactive disintegration, what γ-rays are emitted, approximately how often each is emitted, and how often the nuclear " switch " leads to ejection of an electron from the outer system of the atom. It appears that the action of the nucleus on the electronic structure must be direct and not radiative. The two structures must be regarded as in contact, and capable of collision interaction. According to wave mechanics any quantum-mechanical system in the nucleus, even if situated behind a potential barrier, would be capable of direct interaction with the electronic system, owing to the spread of the wave functions. H. N. A.

538. Intensity of Cosmic Radiation between 55° and 70° North Latitude. A. Corlin. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 22. B. 2. [6 *pp.*], 1930. *In German.*—An account of observations made in 1929 at sea in the Baltic, at the meteorological station in Abisko in North Sweden at latitude 68° 21′ and 388 m. above sea-level, and at sea off the north-west coast of Norway. In the case of the observations in the Baltic followed by those in Abisko, the intensity of the radiation, instead of showing the expected increase with the latitude, exhibited a decrease. The author considers that this result and the results obtained by Clay can be explained on the hypothesis that the cosmic radiation has a maximum zone between 50° and 60° magnetic latitude (over north Germany and south Scandinavia), which on comparison with the more northerly situated maximum zone of the aurora is intelligible on the supposition that the cosmic radiation is harder than the radiation producing the aurora and is thus less deflected in the earth's magnetic field. J. J. S.

HEAT.

539. Thermal Radiation of Thermit. W. Shoulejkin and X. Solowowa. *Zeits. f. phys. Chem.* 149. *Abt. A.* 6. *pp.* 434–438, *Sept.*, 1930.—In his monograph, *Ice Engineering*, Barnes has described successful experiments on the prevention of the formation of a coating of ice on river and sea surfaces by means of a particular ice-thermit, of which the composition was not given. The experiments now described deal with the time-course of the heat radiation during the combustion of various thermit mixtures, use being made of a solarimeter. With ordinary iron thermit (300 grams of powdered aluminium + 900 grams of Fe_3O_4), the maximum radiation effect amounts to 38 kW. This figure is raised to 256 kW when the iron oxide is replaced by manganese dioxide and to 2080 kW when it is replaced by potassium permanganate. T. H. P.

540. Heat-Loss from a Plate Embedded in an Insulating Wall. F. H. Schofield. *Phil. Mag.* 10. *pp.* 480–500, *Sept.*, 1930.—A mathematical treatment of the two-dimensional problem of the steady flow of heat from a rectangular isothermal plate embedded in an insulating wall with rectangular isothermal boundaries. The use of measurements of the electrical resistance of sheet metal as a means for checking and extending the theoretical results is described, and consideration is given to the three-dimensional case of a finite plate within a finite wall as the basis of a simplified apparatus for testing insulators. AUTHOR.

541. Dimensional Changes Caused in Glass by Heating Cycles. A. Q. Tool, D. B. Lloyd and G. E. Merritt. *Bureau of Standards, J. of Research*, 5. *pp.* 627–646, *Sept.*, 1930.—In obtaining expansivity curves for a medium flint glass, samples of the glass were tested which had previously received one or another of several different heat treatments, and in these tests heating cycles were employed which made it possible to determine the magnitude of the so-called "permanent" changes in length which are caused either by the annealing or the "disannealing" which may result from the heat treatment imposed on the glass by the heating cycle employed. Annealing decreases the length and specific volume, while disannealing increases them. It is shown that these effects are related to certain ice-point shifts observed in thermometers, and to other effects sometimes observed in various types of glassware. AUTHORS.

542. Behaviour of Glasses while Softening. G. Tammann. *Zeits. f. Elektrochem.* 36. *pp.* 665–675, *Sept.*, 1930.—*Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June*, 1930.—A general investigation of glass-like substances, with a view to determining for each of them a more or less definite temperature during the softening process, at which the glass ceases to be a pliable solid and becomes a viscous fluid. The following process is found to give a satisfactory result:—Glasses which melt easily are liquefied in a test tube and spread over its walls; glasses which require a higher temperature are treated in the same way in a platinum crucible. After cooling, a layer of glass with surface tension is left on the wall of the vessel. This can be tested by touching the surface with a hard point, which will cause cracks if the glass has become solid, but not if it is still a viscous fluid. Repeated tests make it possible to fix the point at which the change of state occurs within narrow limits. For glasses which melt easily this temperature can be determined within ± 0·5° C., and for those melting at a high temperature, such as the silicate glasses, within ± 5° C. H. N. A.

543. Thermometric Lag of Aircraft Thermometers, Thermographs and Barographs. H. B. Henrickson. *Bureau of Standards, J. of Research,* 5. *pp.* 695–709, *Sept.*, 1930.—A constant which will be called the time lag has been determined experimentally for thermographs, barographs, and of the temperature element of a Fergusson meteorograph. When the instruments are exposed in the same medium and to the same ventilation this constant can be used to evalute their thermometric lag. For the purpose of comparison this constant was also measured for a number of laboratory thermometers. The tests on the thermometers and thermographs were made in an air stream of 17 m.p.h., and those on the barographs in still air and in an air stream of 10 m.p.h. Results for the thermometers show that the liquid-filled type has the greatest time lag and therefore under similar conditions of exposure the greatest thermometric lag, followed in order by the bimetallic strip type and the electric resistance thermometers. All of the barographs, even the metal-cased types, have a far greater time lag than the thermometers, but the lag is reduced considerably by moderate ventilation. The lag of the thermometers ranged from 3 to 72 seconds, whereas that of the barographs in still air ranged from 22 to 64 minutes. The lag of the temperature element of the meteorograph was found to be 3 minutes in still air and 11 seconds in an air stream of 17 m.p.h. AUTHOR.

544. Optical Determination of High Metallurgical Temperatures. Melting Point of Iron. C. H. M. Jenkins and Marie L. V. Gayler. *Roy. Soc., Proc.* 129. *pp.* 91–114, *Sept.* 3, 1930.—Three methods are employed for the determination of the melting point of iron, *viz.*: (1) the "squatting wire" method, in which the sample is placed across the leads of thermoelements introduced into the furnace; (2) Holborn and Kurlbaum's "disappearing-filament" type of optical pyrometer, applied to an ingot of the metal; and (3) the same optical method applied to the inside of a gas-bubble blown in the molten metal. The preparation of the special crucibles necessary to prevent contamination of the metal is described in detail: the refractory material must be free from silica, and the most effective mixture found contains CaO 35 %, Al_2O_3 65 %. To ensure the emission of true black-body radiation, baffles are employed in the sighting tube, and the selective absorption arising from metallic vapours in the tube is avoided by flushing the crucible with a slow current of hydrogen. The optical pyrometer is calibrated by acceptance of the melting points of palladium (1555° ± 2 °C.) and of gold (1063° C.); that found for iron of very high purity by the optical method is 1527° ± 3 °C. Method (1) is found suitable, with platinum-alloy thermoelements, up to about 1450° C., but the optical method is preferable at higher temperatures. Method (3) works well for iron, but is not of general applicability, since with some metals (*e.g.* gold) the inside of the bubble becomes corrugated when the metal solidifies. L. V. C.

545. New Fixed Temperature Points. O. Redlich and G. Löffler. *Zeits. f. Elektrochem.* 36. *pp.* 716–721, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June,* 1930.—Three fixed points from − 10° C. to + 30° C. are considered, with a view particularly to the calibration of thermocouples which are to be used for observing small temperature differences. The determinations were made by a platinum resistance thermometer, and are expressed on the International Temperature Scale. As a check on the accuracy, the transformation point of sodium sulphate was determined, the value found being 32·383° C. in agreement with the value found by Richards, and by Dickinson and Muller. For the transformation point $NaNO_3$; $Na_2SO_4 . 10H_2O \longleftrightarrow NaNO_3 . Na_2SO_4 . H_2O$, the value found was 13·154° C. The transformation point of sodium sulphate in the presence of sodium chloride is at 17·878° C., and the eutectic point of calcium chloride at $-10{\cdot}645_5$° C. J. H. A.

546. Boiling Point of Water as a Function of Pressure. A. Zmaczynsky and A. Bonhoure. *J. de Physique et le Radium*, 1. *pp.* 285–291, *Sept.*, 1930.—Measurements have been made between pressures of 683 mm. and 832 mm. of mercury, using two Swietoslawski ebullioscopes, and two resistance thermometers. A precision mercury barometer and a water manometer were employed to determine the pressures. A formula has been found, the values calculated from which agree very closely with the measured ones, it contains p, p^2 and p^3. A table is given in which the results are compared with those of Regnault, and of more recent observers. **Errata,** *ibid.*, p. 339, Oct., 1930. H. N. A.

547. Intensive Drying of Liquids. A. Smits. *J. Phys. Chem.* 34. *pp.* 1861–1865, *Aug.*, 1930.—Replying to Lenher [see Abstract 691 (1930)] the author summarises the precautions taken by him to avoid superheating of intensively dried liquids during boiling-point determinations. He refers to his experiments on benzene in which a progressive rise in boiling point was observed during months of intensive drying. Steady boiling was always observed, whereas in Lenher's experiments the absence of ebullition proves that superheating must have occurred. Moreover, in Smits' experiments the production of a leak admitting a small quantity of moist air resulted in a return to the normal boiling point. L. V. C.

548. Specific Heat of Mercury near the Melting Point. L. G. Carpenter and L. G. Stoodley. *Phil. Mag.* 10. *pp.* 249–264, *Aug.*, 1930.—The specific heat has been measured to an accuracy of about 1% from 197° K. to 285° K., the melting point being at $234{\cdot}2_3$° K. When corrected to give values of C_v, the curve becomes nearly flat, but higher than the theoretical value of $3R(= 5{\cdot}95$ cals. per gm. per 1° C.). The value for the liquid shows a linear decrease with increasing temperature and the liquid and solid have almost the same specific heat at the melting point. The various theories of the rise near the melting point are passed in review. J. H. A.

549. Specific Heats and Latent Heat of Fusion of Ice. W. H. Barnes and O. Maass. *Canad. J. of Research*, 3. *pp.* 205–213, *Sept.*, 1930.—Values for the heat capacities of ice and resulting water from initial temperatures of between 0° C. and − 78·5° C. to a final temperature of + 25 C. are measured to ± 0·05 % or better with an improved adiabatic calorimeter previously described [see Abstract 4051 (1930)]. The specific heats of ice over the temperature range 0° C. to − 80° C. are found and the latent heat of fusion of ice at 0° C. is obtained from these heat capacity determinations. AUTHORS.

550. Density of Vapours in Equilibrium with Water, Ethyl Alcohol, Methyl Alcohol and Benzene. (Earl of) Berkeley and E. Stenhouse. *Roy. Soc., Phil. Trans.* 229. *pp.* 255–286, *June* 20, 1930.—The investigation aims at a comparison of the saturated vapour densities in air and other gases of liquids of widely different molecular weights, to detect any departure from Dalton's law due to mutual attractions between molecules of the vapour and those of the gas. A precision method is described, in which air (or hydrogen, helium or argon) is slowly led through a train of vessels, two of which contain the liquids investigated and intermediate ones contain pure sulphuric acid as an absorbent. A detailed analysis of the various corrections required for work of the highest accuracy is given; diffusion, giving rise to non-calculable errors, must be minimised by employing a relatively rapid current of gas. No definite indication of a departure from Dalton's law is obtained, but the experimental results are used to calculate the degrees of association at 0·75° C. and at 30·02° C. of water and of ethyl alcohol, assuming that only single and double molecules are present. Benzene is found to be slightly associated at 6·45° C. L. V. C.

551. Vapour Pressure of Aqueous Solutions of Hydrated Salts. J. Perreu. *Comptes Rendus,* 191. *pp.* 254–257, *Aug.* 4, 1930.—The coefficient i in le Chatelier's differential solubility equation is determined for sodium hyposulphite (decahydrate), sodium sulphate (decahydrate) and manganous chloride (tetrahydrate), by measuring the vapour pressure of two solutions of each salt of different concentrations in the neighbourhood of saturation, and substituting these values in the equation $i = (\log p_1 - \log p_2)/(\log c_1 - \log c_2)$. A. J. M.

552. Change of Vapour Pressure at a Curved Liquid Surface. M. Thomä. *Zeits. f. Physik,* 64. 3–4. *pp.* 224–236, 1930.—Employing a form of optical interference manometer having a sensitivity of 2×10^{-11} atm. the author has confirmed the accuracy of Kelvin's formula for the change of vapour pressure at a curved liquid surface, in the case of isovalerianic acid. J. S. G. T.

553. Vapour Pressures of Liquids. Part I. K. Watanabe. *Tokyo B.D., Sci. Reports, Sect. A.* 1. *pp.* 1–13, *Sept.* 3, 1930. *In English.*—This entirely mathematical paper derives the equations of vapour pressure and latent heat of evaporation without any very special assumptions, and an expression is obtained for the chemical constant of a pure substance which is in accord with the behaviour of mercury. H. H. Ho.

554. Corresponding State of Maximum Surface Tension of Saturated Vapours. J. L. Shereshefsky. *J. Phys. Chem.* 34. *pp.* 1947–1950, *Sept.,* 1930.—An extension of the work of Barbulescu on the surface tension of a saturated vapour [see Abstract 2600 (1930)], connecting surface tension of the vapour, (σ_v); height of rise of liquid in capillary of radius r, (h); and the density of the saturated vapour, (ρ_v) in the expression, $\sigma_v = \frac{rh}{2} \cdot \rho_v$. A general behaviour of saturated vapours was noted, namely, that in the neighbourhood of the critical temperature the surface tension reached a maximum, and the ratio of the temperature at this maximum to the critical temperature was constant for several saturated vapours discussed. The maximum is, therefore, characteristic of all substances, and an attempt is made in the present paper to relate it to the

critical constants, as also to deduce an expression that would adequately define it. Such an expression relating surface tension of saturated vapours with temperature is deduced and is of the form $\sigma_v = K(1 - T_1T_c)\rho_v$. Using this expression a table is compiled for a large number of substances. It is shown that the ratio of the temperature at which the surface tension is a maximum to the critical temperature is actually a constant, *i.e.*, $T_m/T_0 = 0 \cdot 910$ for all substances. It is further proved that the slope of the curve log ρ_v/log T at T_m is a universal constant with a value $U = 10 \cdot 1$, where ρ_v is the vapour density and T the absolute temperature.
S. G. B.

555. Kinetic Theory of Gases. G. Jaffé. *Ann. d. Physik*, 6. 2. *pp.* 195–252, *Aug.* 16, 1930.—Consideration is given to a far-reaching analogy between the kinetic theory and that of the anisotropic radiation field. If the kinetic theory is considered, not in respect of the processes in any particular portion of the gas, but with reference to some definite " swarm " of molecules, it is stated that the laws according to which the number of the molecules in this swarm (its " intensity ") alters during its progress through the mass of gas are completely analogous to the laws that deal with the intensity of radiation of an elementary pencil of rays in the radiation field. The author bases this analogy on the Boltzmann integro-differential equation, which is regarded as fundamental, transformed in the absence of external forces for arbitrary values of the parameter, and then found to agree formally with the equation of movement of the radiation in the anisotropic field of radiation. Frequent reference is made in the calculations to Enskog's dissertation [see Abstract 802 (1923)] on the kinetic theory of the processes in moderately rarefied gases. The distribution function (f) of distances, velocities and time is developed according to general spherical functions. The coefficients of this development have each a physical importance. The author discusses the integro-differential equations for the individual orders and their connection with the so-called transport equation. He also deals with the elimination of velocity from the expression for f, and with equations for the first three orders in explicit form. In the development according to spherical functions it was intended to base upon it a calculation of the function f for small values of the parameter λ. For this purpose a suitable development is according to powers of a quantity proportional to the mean free path. A further development using reciprocal powers of this quantity leads to a new method of solution of the fundamental equation. T. B.

556. Relativity Gas Theory. V. Danilow. *Zeits. f. Physik*, 63. 9–10. *pp*. 692–696, 1930.—The form of the equation $pV = \frac{2}{3}E$ between the pressure, volume and kinetic energy of the molecules of a perfect gas is generalised to take account of the relativity variation of mass with velocity. Also quantum mechanics is used. The form of the equation is unchanged, but a new expression for E is developed. G. C. McV.

557. New Method of Measuring Pressure Variation of Specific Heats (C_p) of Gases. E. J. Workman. *Phys. Rev.* 36. *pp.* 1083–1090, *Sept.* 15, 1930.—A method is described whereby the ratio of c_p at a high pressure to c_p for the same gas at a pressure of one atmosphere taken as a standard is determined. The continuous flow principle is used in such a way that the necessity for measuring gas flow and heat input is avoided. A stream of gas at high pressure is brought to a temperature t_1 and passed through a heat interchange acquiring there a temperature t_2, after which it is throttled to atmospheric pressure, brought to a temperature t_3 and returned to the heat interchanger, where its temperature again becomes t_2. The ratio of c_p at a high pressure to that at atmospheric pressure is equal then to $(t_3 - t_2)/(t_2 - t_1)$ plus certain small corrections. Measurements on commercial oxygen taken at a mean temperature of 26° C. and pressures ranging from 15 to 100 atmospheres indicate a pressure coefficient of this ratio of $0 \cdot 00165 \pm 0 \cdot 00005$ per atmosphere. AUTHOR.

558. Pressure Variation of Specific Heats of Gases Derived from Compressibility Data. L. G. Hoxton. *Phys. Rev.* 36. *pp.* 1091–1095, *Sept.* 15, 1930.—Values of the rate of variation of c_p with pressure at constant temperature as calculated from p-v-T data and as determined by direct experiment are compared for oxygen and air over a pressure range of 20 to 100 atmospheres and at 26° C. The calculated values, while of the same order of magnitude as the experimental, are shown to be very sensitive to small variations in the coefficients of the "equation of state" employed; also to modifications in the method of approximation used in handling such equations. The conclusion is reached that this rate probably diminishes slowly with rising pressure for oxygen in the field considered and that its calculated values cannot at present approach in accuracy what may reasonably be expected from direct calorimetric experiments. AUTHOR.

559. Theory of Adiabatic Invariants. W. Glaser. *Zeits. f. Physik,* 64. 3–4. *pp.* 214–223, 1930.—The law of Gibbs and Hertz, according to which the phase-volume of a simple imprimitive system is an adiabatic invariant, is extended to systems of imprimitive order *m*, and it is shown that here adiabatic invariants, defined by means of analogues of phase volume, occur. [See Abstract 3043 (1930).] J. S. G. T.

560. Virial of the Lorentz Forces and the Pressure of Radiation. S. C. Kar. *Zeits. f. Physik,* 64. 3–4. *pp.* 292–294, 1930.—An expression for the virial of the Lorentz electron forces is derived in vector form and the expression for the pressure of radiation deduced directly therefrom. J. S. G. T.

561. Sama State in the Atmosphere. R. v. Dallwitz-Wegner. *Zeits. f. Physik,* 64. 5–6. *pp.* 439–442, 1930.—In this paper the author attempts to prove that heat (with the exception of radiant heat) is not lost by radiation from the earth to the atmosphere, but is prevented by the existence of the Sama state in the atmosphere. Abnormal quantities of heat produced in the atmosphere by winds from warmer regions, radiation from the sun or by condensation of water vapour from the earth, flow to the earth against the temperature gradient (rise of temperature towards the earth) due to the Sama effect. T. B.

562. Calculation of Irreversibility. W. Jazyna (Jacyno). *Zeits. f. Physik,* 64. 11–12. *pp.* 856–859, 1930.—Gives, with the help of polytropic properties and distribution coefficients, the general functional forms of the inner thermal and the mechanical degrees of irreversibility; also the difference between the dynamic temperature T_d and the conditionally-reversible (*bedingt-reversible*) temperature T_r. Some applications are made to practical cases in piston machines, with the degree of irreversibility between 0·00002 and 0·0004, and $T_d - T_r < 0 \cdot 05°$ C. [See also Abstracts 3780, 3781 (1930).] H. N. A.

SOUND.

563. Numerical Relations of Musical Scales. S. C. P. H. Hofbauer. *Pont. Accad. Sci., N. Lincei, Atti,* 83. *pp.* 172–175, *March* 16, 1930. *In German.*—The diatonic scale may be represented by a series of functions of the interval *c–d*, or the ratio 9/8. Denoting this interval by t, e will be t^{t+1}, and the exponents of f, g, a, b and c will be respectively $2t + \frac{1}{2}$, $3t + \frac{1}{2}$, $3t + \frac{3}{2}$, $4t + \frac{3}{2}$ and $5t + 1$. E. E. F. d'A.

564. Temperature Effect on Bell Pitch. A. T. Jones. *Acoustical Soc. of America, J.* 1. *pp.* 382–384, *April,* 1930.—With the aid of a set of tuning forks rated at 0° and 30° C., and the assumption of a linear change in pitch with temperature change, the pitches of the first, third and fifth partials of a particular bell were determined at different temperatures. A slight lowering of pitch with increase of temperature is found. [See also Abstract 3501 (1930).] W. H. Ge.

565. Musical and Physical Standards of Pitch. W. B. White. *Science,* 72. *pp.* 295–296, *Sept.* 19, 1930.—A plea for the adoption by physicists of the musicians' A440 pitch, which is now used by virtually all the symphony orchestras of the world. Physicists still retain the C256 (A430·5) pitch, and in France the A435 pitch remains the standard. G. E. A.

566. Method of Showing the Modes of Vibration of a Wire. C. R. Darling. *Phys. Soc., Proc.* 42. *pp.* 488–489, *Aug.* 15, 1930.—A method is described of showing the modes of vibration of a wire by heating it with an alternating electric current and varying its tension, the various modes being easily observable owing to the luminosity of the wire. Author.

567. Sound Transmission of a Partition. A. E. Knowler. *Phil. Mag.* 10. *pp.* 342–344, *Aug.,* 1930.—Describes a third method additional to those of Watson and Sabine for measuring sound transmission through a partition between two rooms A and B. A moving-coil loud-speaker is placed with a compensating slab of absorbing material in room A and the current reduced until the sound is just audible in room B. The experiment is then repeated with both loud-speaker and hearer in room B. The pair of observations are next repeated, starting with the speaker in room B. From these observations the sound transmission of the dividing wall can be calculated. Theory and typical results are given. Unlike the other methods, the present method can readily be applied to measurement of the sound transmission of the walls of existing buildings. W. H. Ge.

568. Velocity of Sound and Temperature of the Stratosphere. B. Gutenberg. *Gerlands Beitr. z. Geophys.* 27. 2. *pp.* 217–225, 1930.—Records recently obtained of sound waves in the atmosphere are found to confirm conclusions previously drawn from aural observations. The recent results show that the height at which the velocity of sound and the temperature begin to increase is not the same in all cases. Sometimes, particularly in winter, this height may be not more than 20 km. A simple method of calculation is given to find the velocity of sound in the stratosphere. A. W.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

569. Method of Mapping Equipotential Lines and Application to Electric Precipitator Problems. A. W. Simon and L. C. Kron. *Rev. Sci. Instruments*, 1. *pp.* 527–536, *Sept.*, 1930.—A quantitative method of mapping a series of equipotential lines corresponding to definite fractions of the total voltage drop between electrodes is described. The accuracy of the method is tested by mapping several known fields, such as the field between concentric cylinders and that between parallel cylinders. The application of the method to electrostatic problems, in particular to the study of electric precipitation, is indicated. AUTHORS.

570. Rounding of the Edges of Plate Condensers in Normal Air. W. Schilling. *Arch. f. Elektrot.* 24. *pp.* 383–396, *Sept.* 27, 1930.—A mathematical discussion of the question. The conclusion is reached that in air for a plate condenser a considerably more strongly curved formation of edge is possible than has hitherto been indicated. J. J. S.

571. Molecular Electric Moments. H. Müller and H. Sack. *Phys. Zeits.* 31. *pp.* 815–822, *Sept.* 15, 1930. *Paper read before the Deut. Phys. Gesell., Halle, June*, 1930.—This paper records measurements of dipole moments in non-polar solvents, full experimental details being included. The following substances were measured in benzene solution: bromo- and chloro-benzenes; methylene chloride, bromide and iodide; chloroform, bromoform and iodoform; the following acetates: methyl, ethyl, *n*-propyl, *n*-butyl, isobutyl, amyl, sec. octyl and benzyl; cetyl alcohol; 9-bromoanthracene; 1–2 trans dichloroethylene; and 1–2 cis-dichloroethylene. The following products were examined in hexane solution: iodoform, methylene bromide and iodide. The results obtained are compared where possible with the data of previous investigators and found to be satisfactory in all cases. The dipole moments of the members of an homologous series appear to be approximately constant, and replacement of a methyl by a benzyl group does not appear to change the moment appreciably. H. H. Ho.

572. Dielectric Polarisation of Liquids. Part X. Polarisation and Refraction of the Normal Paraffins. R. W. Dornte and C. P. Smyth. *Am. Chem. Soc., J.* 52. *pp.* 3546–3552, *Sept.*, 1930.—The dielectric constants and densities of the normal paraffins from pentane to dodecane have been measured over almost the entire temperature range within which these substances are liquid at atmospheric pressure, and the refractive indices and dispersions have been determined at 20° C. The polarisations calculated from the dielectric constants and densities increase about 1 % per 100° rise in temperature. The molar refractions at different wavelengths for the CH_2 group agree with previous data, and the constancy of their polarisation indicates, in the absence of an electric moment, that polarisation is an additive property. The absence of any decrease of polarisation with rising temperature and the same difference between the polarisations and refractions show that the values of the electric moments of the molecules are indistinguishable from zero. The conclusion is drawn that the bands of alkyl radicals possess no polarity detectable through electric moments arising from them. H. H. Ho.

573. Influence of Strong Electric Fields on the Dielectric Constants of Liquids. H. Gundermann. *Ann. d. Physik,* 6. 5. *pp.* 545–573, *Sept.* 17, 1930.—The dependence of the change of dielectric constant with electric field strength has been experimentally investigated by the Wien-Malsch single-spark method, and found to be diminished proportionally to the square of the applied field strength. A more accurate investigation in the case of liquids has shown that the effect does not correspond exactly to that given by the simple Debye theory. Mixed polar liquids do not give the expected average values of the dielectric constant, but exhibit other effects due to the reciprocal influence of the dipoles (*e.g.*, with a mixture of equal parts of ethyl and propyl alcohol the dielectric constant is greater than that of the separate components). Mixtures of polar liquids with benzene exhibit various effects according to the nature of the polar liquid, and the dependence of the effect on concentration has been measured for mixtures of benzene with ethyl and butyl alcohols. The anomalous results are explained on the assumption of molecular association. H. H. Ho.

574. Temperature Dependence of the Ionisation Current in Ceresine. D. N. Nasledow and P. W. Scharawsky. *Ann. d. Physik,* 6. 5. *pp.* 574–580, *Sept.* 17, 1930.—From the graphical interpretation of the experimental data there appears clearly to be an exponential relationship between the ionisation current when the ceresine is irradiated by X-rays and the temperature. An analogous regularity was also established for the dark current. [See also Abstract 3791 (1930).] H. H. Ho.

575. Passage of Electric Current through Solid Paraffin in the Dark and under X-Rays. W. M. Tutschkewitsch. *Ann. d. Physik,* 6. 5. *pp.* 622–636, *Sept.* 17, 1930.—This paper is one of a series of investigations concerning the phenomena of current passage through solid dielectrics [see Abstract 3791 (1930)]. Very full experimental details are included, and the dependence of e.m.f. of the polarisation on the voltage is investigated. In the case of paraffin the validity of the similarity principle is established, *viz.*, if the currents at equal average potential gradients in layers of different thickness of the dielectric are equally great, then there is an analogous potential distribution in these layers. H. H. Ho.

576. Relations between Dielectric and Optical Properties in Bodies with the NaCl Lattice. J. Errera. *Zeits. f. Elektrotchem.* 36. *pp.* 818–823, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June,* 1930.—The total polarisation of alkali halides which show the NaCl lattice at ordinary temperatures has been measured. A regular increase of total polarisation is found with increasing atomic weight for both alkalis and halogens, and using Spangenberg's value for electronic polarisation, the atomic polarisation is calculated. Values of $(\epsilon - n_0^2)/\epsilon$ are given for the alkali halides and this ratio decreases with increasing atomic number of anions, being greatest for LiF and least for RbI on account of different electronic deformation and ionic distance. This D.K. value leads to a calculation of the natural infra-red frequency. A comparison of the wave-length thus found with that calculated by Born from assumptions regarding electrostatic attraction allows the determination of important p-factors in the dispersion formula of the infra-red components, and this in the theoretical quantum sense determines the probable transition for the frequency considered. R. S. R.

577. Electric Discharges in Crystals. Lydia Inge and A. Walther. *Zeits. f. Physik*, 64. 11–12. *pp.* 830–844, 1930.—When a dielectric crystal is placed between a point and a plane electrode under oil, and subjected to a surge potential of short duration, the discharge phenomena are marked by great regularity. In crystals of rock-salt four discharge paths are found, starting from a point in the surface and running in the directions of the four diagonals of the crystal cube. With other crystals a similar dependence of the discharge paths on the crystallographic structure is found. With rock-salt the discharge spreads considerably faster when the point is positive and the plane negative than in the reverse case. This effect depends on a difference of mobility of the ions concerned. In all cases the discharge spreads faster when the potential of the point has the same sign as that of the more mobile ions. A. W.

578. Simultaneous Sounding by Atmospheric Parasites at Zurich and over the Sahara. J. Lugeon. *Comptes Rendus*, 191. *pp.* 525–527, *Sept.* 29, 1930.—The method described earlier [see Abstract 4077 (1930)] has been used to locate the cold front of a stormy region between New York and Bermuda at a distance exceeding 8000 km. and to many Mediterranean depressions. An expression has been obtained of the form $H = 129 \cdot 782 - 58 \cdot 316 \sin^2 \phi$ connecting the height (H) of the Heaviside-Kennelly layer and the latitude (ϕ). This gives a mean height at sunrise of 129·8 km. at the Equator and 71·5 km. at the poles. The registrations indicate also the heights of the ozone layer and the tropopause at sunrise and their inclinations towards the poles. The height of the tropopause agrees well with those of Shaw based on entropy variations. R. S. R.

579. Microcrystalline Nitrogen Particle Envelope Surrounding the Earth's Atmosphere. H. Rudolph. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 378–381, 1930.—A relative weakening of the green line 5577 Å. of the Northern Lights, when compared with other lines in the same source due to ionised nitrogen gas, is obtained when the Northern Lights are illuminated by the sun. This can be considered to indicate a rise in temperature and a partial evaporation of the microcrystals on the daylight side of the earth, in Vegard's nitrogen particle envelope enclosing the normal air envelope. It can also indicate a cooling to below − 237·6° C. and rebuilding of the microcrystals on the night side of the earth. This nitrogen particle envelope due to Vegard, the weight of which may be overcome by electrical repulsion, not only explains the differences in the spectra of the normal and the extremely high sun-illuminated Northern Light radiations, but can also explain the daily variations of the terrestrial magnetism. For the latter, however, the nitrogen particles must be considered to be negatively and not positively charged, as assumed by Vegard. R. C. F.

580. Influence of Rain on the Atmospheric-Electric Field. A. V. R. Telang. *Terr. Mag.* 35. *pp.* 125–131, *Sept.*, 1930.—Photographic records of the atmospheric-electric field variations at times of rain are examined along with pluviograms covering these periods. It is found that the normal effect of rain is to reverse abruptly the normal positive field in the early stages, while in a few cases it results in a sudden reduction without change of sign. This abrupt change disappears speedily when the disturbing shower is of short duration. An analysis of the results of G. C. Simpson at Simla (1908–1909) in regard to the charge brought down by rain is given. It is shown that in the earliest stages of charged rain, in more than 85 % of the cases the net charge brought down by rain is positive. It is then shown that the effect of rain on the field is due to the transfer of charge by the rain from the upper air. Calculation shows that the charge transferred by the rain is of the order necessary to produce the observed changes of potential. The explanation covers the cases of heavy rain attended with frequent reversals and very high values of the field.

AUTHOR.

581. Earth Movements and Terrestrial Magnetic Variations. R. Gunn. *Terr. Mag.* 35. *pp.* 151–156, *Sept.*, 1930.—It is shown that a general contraction of the earth or a movement of a small part of it may give rise to appreciable disturbing magnetic fields. The movement of a conducting region inside the earth across the earth's magnetic field sets up e.m.f.s which may produce large current-systems. These current-systems can give rise to the observed magnetic variations if the conductivity of the earth's core is sufficiently large. Earlier determinations of the resistivity of the earth's core are found to be to several orders of magnitude too high, due to the neglect of skin-effects. It seems probable that the electrical time-constant of the earth's core is not less than 1000 years, and therefore magnetic diurnal-variation data cannot be used to calculate its conductivity. AUTHOR.

582. Norwegian Arctic Expedition in the Gjφa, 1903–1906. Part III. Terrestrial Magnetism Photograms. *Geofysiske Publ.* 8. [17 *pp.*], 1930.

583. Theories of Terrestrial Magnetism. F. E. Smith. *Nature*, 126. *pp.* 402–405, *Sept.* 13, 1930. *Paper read before the British Assoc., Bristol, Sept.*, 1930. *Observatory*, 53. *pp.* 297–302, *Nov., and pp.* 339–342, *Dec.*, 1930.—Gauss and Schuster have given some very valuable criteria of the earth's magnetic field. The secular variation may be regarded as caused by change in direction of the axis of magnetisation, but the movements of the magnetic field are very complex. Another theory is that the magnetic field is due to electric currents circulating round the earth. Gunn has suggested that the magnetic field is due to electrical currents set up inside the earth in the high temperature regions where the thermal motions are considerable. The author considers the possible ways in which a body may by virtue of its rotation act like a magnet. The field may be due to some departure from the commonly accepted laws of electrodynamics. The paper goes on to consider vertical electric currents, daily variations, sunspots and magnetic storms, and concludes by pointing out the need for more precise data. T. C. H.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

584. Electrons in Metal and Bragg's Conditions of Selective Reflection. L. Brillouin. *Comptes Rendus*, 191. *pp.* 198–200, *July* 28, 1930. *J. de Physique et le Radium*, 1. *pp.* 377–400, *Nov.*, 1930.—The author considers a cubic network, through which move free electrons, and proceeds to show the formation of the de Broglie wave ψ which corresponds to them in a mathematical form and reaches the condition enunciated by Bragg. The results obtained for a network of three dimensions generalise those obtained by the author for a network of one dimension where the equation of the wave is of the Mathieu type. The author considers anomalous waves and shows how the energy suffers discontinuity. The paper should be referred to, as it cannot conveniently be abstracted. [See also Abstract 2262 (1930) and following Abstract.]

T. C. H.

585. Electrons in Metals and Classification of the Corresponding de Broglie Waves. L. Brillouin. *Comptes Rendus,* 191. *pp.* 292–294, *Aug.* 11, 1930.—The mathematical expression for the de Broglie waves associated with electrons, both bound and free, in metals is indeterminate in character. The author seeks to remove this indeterminancy by assuming that inequalities of potential throughout the ionic lattice tend to vanish. Expressions for wave-lengths and energy of de Broglie waves associated with the electrons are deduced on this assumption. [See also Abstract 2681 (1928) and preceding Abstract.]

J. S. G. T.

586. Electric Conductivity of Sodium Chloride Crystals. B. Hochberg and A. Walther. *Zeits. f. Physik,* 64. 5–6. *pp.* 392–401, 1930. —Measurements have been made between 25° and 800° C., and it has been shown that the conductivity between 25° and 550° C. is represented by the formula $\sigma = Ae^{-B/T}$. Below 270° C. polarisation commences, and in the region from 270° to 140° C. takes place so quickly that it has not been possible to measure the initial current, even with the help of a specially constructed commutator, although this made it possible to determine the current 0·001 second after the potential difference was applied. The relation between the residual electrical conductivity and the temperature is represented by the above formula, but with other constants at these temperatures. Above 550° C., in addition to the conductivity due to the Na^+ ions, there is conductivity due to the Cl^- ions, which adds another term to the above temperature formula. This has been proved by experiments made by B. D. Tasulachov.

H. N. A.

587. Electrical Resistance of Nickel and Permalloy Wires as Affected by Longitudinal Magnetisation and Tension. L. W. McKeehan. *Phys. Rev.* 36. *pp.* 948–977, *Sept.* 1, 1930.—A review is given of previous work on " magneto-resistance " and " elasto-resistance " of nickel and nickel-rich alloys at room-temperature or lower. The effects of longitudinal magnetisation and tension are then detailed for permalloys containing from 45 to 90 % of Ni. Adequate explanations of both effects may be given in terms of atomic orientation, provided that (i) each atom has a fixed magnetic moment and a magnetic axis definitely related to its mechanical symmetry; (ii) magnetisation is effected by two processes termed reversals and partial rotations of atomic magnets; (iii) electrical conduction is affected primarily by the atomic magnetic fields within single atoms, secondarily by the mutual aspect of adjacent atoms, and little or not at all by applied fields of the order of a few thousand gauss.

G. E. A.

588. Change of Resistance of Nickel Wire under Simultaneous Stretching and Heating. S. Arzibyschew and W. J. U. Juschakow. *Zeits. f. Physik,* 64. 5–6. *pp.* 405–410, 1930.—The resistance change was measured when nickel wire at various temperatures was stretched mechanically. To eliminate the effect of small temperature fluctuations a second piece of similar wire was placed in the other arm of the Wheatstone bridge, and was not stretched. At room-temperature the resistance passes through a minimum at about 0·05 % elongation and then increases again. At higher temperatures the minimum is less pronounced and occurs at a smaller elongation. It disappears entirely at the Curie point, after which the effect of stretching is to increase the resistance almost linearly. The curves in general show definite hysteresis. It is concluded that the shape of the curves is connected with the magnetic nature of nickel. J. H. A.

589. Change of Resistance of Thin Sheets of Bismuth in the Magnetic Field. F. Gross. *Zeits. f. Physik*, 64. 7–8. *pp.* 520–536, 1930.—In a magnetic field of 28,000 gauss the change of resistance of bright and grey sheets of bismuth was investigated as regards its dependence on the method of production, on the thickness of the sheet (up to 6 μ) and its position relative to the lines of magnetic force. With increasing thickness the specific conductivity and the change of resistance increase up to limiting values. The influence of the position relative to the lines of force is connected with the fibrous texture of the sheets. Sheets were found which, with a resistance of some ohms, exhibited a change of resistance of 90 to 100 % against 140 % for a Bi spiral. J. J. S.

590. Change of Metallic (Electrical) Resistance in Intense Magnetic Fields. N. H. Frank. *Zeits. f. Physik*, 64. 9–10. *pp.* 650–656, 1930.—For the proportional change of electrical resistance, $\Delta\rho/\rho$, of a metal in a magnetic field of strength H, the author deduces the equation $\Delta\rho/\rho = BH^2/(1 + CH^2)$, on the basis of Sommerfeld's theory. The equation satisfactorily explains the departure from a square law found by Kapitza in the case of strong fields [see Abstract 2580 (1929)].

J. S. G. T.

591. Relation between Field Intensity, Back E.M.F. and Conductivity in Ionic Crystals. O. Beran and F. Quittner. *Zeits. f. Physik*, 64. 11–12. *pp.* 760–776, 1930.—Gives a method by means of which the back e.m.f. can be determined as soon as 10^{-6} sec. after the voltage has been switched off. The back e.m.f.s of NaCl and KCl crystals have been measured between 100° and 200° C., with voltage up to 800 volts (28,000 volt/cm.). The relation between the field intensity and the apparent conductivity (final current/applied voltage) is given by a Poole formula above 100,000 volt/cm. even at high temperatures. The van't Hoff relation between the apparent conductivity and the temperature persists even for high field intensities. The true conductivity increased considerably up to field intensities of 35,000 volt/cm., which contradicts Joffe's assumption that the true resistance is constant; it follows a van't Hoff relation, but with other constants than in the case of the apparent conductivity. It appears that the increase of the true ionic conductivity of these crystals with the temperature depends exclusively on Smekal's "loose ions." H. N. A.

592. Electrical Conductivity Measurements at Low Temperatures. J. C. McLennan, J. F. Allen and J. O. Wilhelm. *Phil. Mag.* 10. *pp.* 500–511, *Sept.*, 1930.—It has been shown [see Abstract 2621 (1930)] that alloys composed of a superconductor and an element of the fifth group have a higher superconducting point than that of the superconductor alone. Various metals alloyed with those of the fifth group were examined in the hope that their superconducting point would be raised sufficiently to be noted. The alloys Ag-Bi, Cu-Bi, Cd-Bi, Mn-Bi, were examined down to 1·9° K. and none became superconducting, although the Mn-Bi curve showed a pronounced drop in resistance near the low-temperature end. The alloys Cu-As and Au-As also gave results indicating that if lower temperatures were available they might become superconducting; Ag-Sb and Cd-Sb showed no such tendency. Pure samples of Ce and La were then examined; the resistance curve for the former dropped considerably at 1·9° K., as also did the alloys of each of these metals with Pb. Negative results were also obtained for FeS, AgS, Bi_2S_3, CuO, $AgCl_2$, Heusler alloy, eutectic alloy of Cd and Zn, and Po. W. C. S. P.

593. Measurements with the Aid of Liquid Helium. Part IX. Superconductivity of Carbides and Nitrides. W. Meissner and H. Fränz. *Zeits. f. Physik*, 65. 1–2. *pp.* 30–54, 1930. *From the Reichsanstalt.*—Temperatures were measured, according to the region under investigation, with a resistance thermometer of lead or of constantan, or by static measurement of the vapour pressure of liquid helium. The substances studied are set out below:—

Substance.	Impurities (%).	Temperature for Superconduction.
Vanadium nitride	0·6	1·3° K.
Titanium nitride	2	1·6° K. with a further rise at 2·7–3·9° K.
Zirconium nitride.........	7–10	6·2°–7·9° K.
Mixed crystal, titanium and zirconium nitrides	—	3·2°–3·6° K.
Scandium nitride	5	Not reached; below 1·4° K.
Cadmium oxide	—	Not reached; below 1·4° K.
Molybdenum pentoxide ...	very small traces	Resistance increases with falling temp. as far as 1·3° K.
Tungsten dioxide	very small traces	Not reached; below 1·1° K.
Vanadium carbide........	traces	Not reached; below 1·3° K.
Titanium carbide	0·3	3°–4° K.
Lower molybdenum carbide (Mo_2C)	—	2·5°–3·1° K.
Higher molybdenum carbide (MoC)	0·03	7·6°–8·2° K.
Tantalum carbide	0·1	9·2°–9·8° K.
Niobium carbide	3·4	10·0°–10·6° K.

In each case the paper gives details of the appearance, crystal structure and other physical properties of the material. J. H. A.

594. Measurements with the Aid of Liquid Helium. Part X. Electrical Resistance of Some Alloys. W. Meissner. *Zeits. f. Physik*, 64. 9–10. *pp.* 581–583, 1930. *From the Reichsanstalt.*—The electrical resistances of copper-gold alloys containing respectively (α) 50·3, (β) 25·2 and (γ) 25·24 atomic % of gold have been investigated at temperatures attainable by the use of liquid helium. The results show that the resistance of the tempered sample (γ) decreased very much more rapidly than that of the untempered sample (β) of very approximately the same composition. The decrease was in both cases, however, small compared with that characterising the pure metals. This is interpreted as indicating that an ordered atomic distribution has not been completely attained in the alloys. The electrical resistance of a tempered alloy Ni_3Mn was found to decrease even less rapidly than that of the tempered copper-gold alloy (γ). J. S. G. T.

595. Mechanism of Electrodeless Discharge. J. Thomson. *Phil. Mag.* 10. *pp.* 280–291, *Aug.*, 1930.—A simple theory of the electrodeless discharge is developed. It is suggested that the discharge may be maintained by the ionisation produced by electronic collisions. From this standpoint it has been possible to explain in an approximately quantitative way the variation of the maintenance potential with gas pressure. While the simple equation does not explain the experimental relation between the maintenance potential and the frequency it has been possible to indicate the lines along which it will have to be modified. The application of the Tesla coil transformer to the production of h.t. h.f. oscillations is discussed. By this means it has been possible to set up electrodeless discharges in gases at relatively high pressures. F. J. W.

596. Sparking Potential in Helium. F. Levi. *Ann. d. Physik*, 6. 4. *pp.* 409–433, *Sept.* 4, 1930.—The research described was undertaken with the object of repeating the experiments of Zuber [see Abstract 181 (1927)] using a rare gas of the highest possible degree of purity. Helium was selected for the research and the sparking potential was determined for various values of the product of gas pressure (p) and electrode distance (d). It was found that for helium the sparking potential curve cannot be reproduced so well as in the case of other gases. The results obtained show that for helium of a high degree of purity the sparking potential curve at first falls and then rapidly rises as the product pd increases. It appears probable that the difficulty experienced in reproducing the results is due to the marked influence of the last traces of other gases on the sparking potential of helium, and possibly also to the condition of the electrodes, which appear to have an appreciable effect. A. W.

597. Propagation of Luminosity in Discharge Tubes. J. W. Beams. *Phys. Rev.* 36. *pp.* 997–1001, *Sept.* 1, 1930.—The velocity of propagation of luminosity in long discharge tubes, when a high potential was suddenly applied to one electrode, was studied by means of a mirror rotating between 2000 and 3000 r.p.s. Air and hydrogen at pressures from 0·04 to 0·5 mm. of mercury were used in the tube. The luminosity always moves from the electrode to which the potential was suddenly applied toward the electrode maintained at ground potential. The velocity of the luminosity, after progressing a few cm. from the electrode to which the surge potential was applied, travelled with almost a constant speed, usually within the limits of 10^9 to 10^{10} cm./sec., depending upon the conditions of the experiment. A qualitative explanation of the results is offered based upon the formation of space-charge. AUTHOR.

598. Determination of Temperature in Discharge Tubes by Measurements of Intensity in Band Spectra. W. Lochte-Holtgreven. *Zeits. f. Physik*, 64. 7–8. *pp.* 443–451, 1930.—Quantitative intensity measurements of the rotation structure of C_2- and CH-bands were carried out, and from these the temperatures were calculated. With discharges in C_2H_2 the temperatures of the disintegration products are unusually high. The C_2- and CH-bands taken simultaneously in the same discharge tube show a temperature difference of over 1000° C. In all cases the energy distribution over the rotation level obeys the Boltzmann law. It results that the measured "rotation temperature" is different from the true gas temperature (the "translation temperature"). With discharges in CH_4 the C_2-bands indicate the same temperature as in C_2H_2 (4700°), which it may be concluded is due to the formation and destruction of acetylene under the influence of the discharge. The temperature difference between C_2- and CH-bands is in this case still greater. J. J. S.

599. Electrical Gas Purification. Part II. R. Ladenburg and W. Tietze. *Ann. d. Physik,* 6. 5. *pp.* 581–621, *Sept.* 17, 1930.—This paper continues the work of Part I [see Abstract 3218 (1930)] and considers in particular the effects produced by an electric wind. The older work is first discussed and is followed by a comprehensive description, illustrated by photographs and diagrams, of the electric wind produced by a single glow point at an axial wire in a cylindrical chamber. A section is devoted to the propagation of the wind from a single glow point. Kinematographic measurements of the velocities of the small suspended particles are included, together with an examination of the resultant action of the electric wind from the many glow points of a wire. The reciprocal influences of different glow points and current relationships are considered, and a comparison made of the actual and purely electrical velocities of the suspended particles in a gas purification chamber; in particular the influence of large quantities of dust is investigated. The mechanism of the various processes which occur is briefly discussed. H. H. Ho.

600. Low-Voltage Arc. M. J. Druyvesteyn. *Zeits. f. Physik,* 64. 11–12. *pp.* 781–798, 1930.—Two theories of the low-voltage arc, that of Holst and Oosterhuis and that of Compton and Eckart, are discussed. The latter is extended somewhat and furnishes the most probable explanation of low-voltage arc phenomena. The extension of the theory consists in the assumption of a transfer of energy from rapid to slow electrons; this transfer must take place very frequently for high electron concentration (greater than 10^{12}). The spectrum of the low-voltage arc in argon is next discussed, and experiments on low-voltage arcs in argon and neon are described. The results obtained by probe measurements showed a potential maximum of about 11·4 volts (in relation to the potential of the kathode) for argon and 18·5 volts for neon, corresponding to the excitation potential of the 1*s*-level for argon (11·7 volts) and of the 2*p*-level for neon (18·5 volts). The highest electron concentration was approximately 2×10^{12} electrons/cm.^{3} The probe theory of Langmuir and Mott-Smith is extended and from one formula and the probe characteristic it is found possible, by differentiating twice, to obtain the velocity distribution of the electrons. A. W.

601. Glow Discharge in Hydrogen. R. D. Rusk. *Phil. Mag.* 10. *pp.* 244–248, *Aug.*, 1930.—Measurements of the space potential in the hydrogen glow discharge have been made in the region on that side of the hot filament which is opposite to the anode. It is found that the space potential rises sharply behind the filament to a value which is almost as great as that of the anode potential and drops again sharply at the extremity of the glow. The steep potential gradient behind the filament indicates that electrons not pulled toward the anode will be accelerated in the opposite direction, producing both excitation and ionisation. At higher potentials these electrons would appear to be more responsible for the glow than excitation by radiation. F. J. W.

602. Absorption in Hydrogen Gas of Hydrogen Positive Rays. A. C. Law and G. Mutch. *Phil. Mag.* 10. *pp.* 297–306, *Aug.*, 1930.—In order to simplify the problem the authors used nearly homogeneous positive rays, which were produced in a discharge tube, and passed through a long, narrow hole in the kathode made of Swedish iron. They then passed between the poles of an electromagnet, which could be charged electrically, and so were deflected through a hole in an aluminium plate into an observation chamber, where the intensities of the positive ray beam at different points along its course were compared by photographing the light emitted by it. It was found that the absorption is not exponential, and it is not a case of the removal of protons by sudden stoppage or large angle scattering. The decrease in velocity must be gradual, an important factor, which prevents the method from giving quantitative results. At a certain distance along the path a rapid decrease in luminosity occurs, and this is probably the place where the energy is so reduced that the emitting power is seriously diminished. Henderson's formula does not seem to account for the observed diminution in velocity; it also fails in the case of α-rays. A factor of 2, which is needed in the latter case, would make the results obtained with H-rays plausible. H. N. A.

603. Doppler Effect with Slow Hydrogen Canal Rays. F. Ney-Valerius. *Ann. d. Physik*, 6. 6. *pp.* 721–738, *Sept.* 25, 1930.—Experiments were carried out on the Doppler effect of slow hydrogen canal rays of 400 to 1200 volts. The results obtained show that the maximal velocity of the Doppler effect agrees in general with the kathode fall velocity, calculated from the kathode fall of potential for a value of e/m of 9650. The ratio v_2/v_1 of the two velocity maxima between 400 and 1000 volts was found to depend on the gas pressure, being relatively large at low pressures and becoming smaller as the pressure increases. Between 1000 and 1200 volts four maxima were observed, these being preceded below 1000 volts by a broadening of both Doppler bands. Using a spherical discharge apparatus only the three slower maxima were observed between 1000 and 1200 volts, while a cylindrical tube gave four. The maximum of fast Doppler bands is, in general, for the spherical apparatus, displaced towards the lower velocities as compared with the results obtained with the cylindrical tube. The difference between the two types of apparatus is explained as being due to the numbers of the ions of different mass (H_1^+, H_2^+, H_3^+) in the cylindrical tube having different ratios from those in the spherical type of apparatus. A Doppler effect was also observed for the backward stream of canal rays and for these also two velocity bands were found. A. W.

604. Influence of Kathode Rays on Swelling Power. K. Przibram. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 1–2. *pp.* 105–106, 1930.—By the radiation of thin zapon varnish layers with kathode rays, it is shown that astonishingly regular fold systems occur which are due to a reduction of the swelling power during development. A consideration of the analogous action, observed for kathode rays, on gelatin indicates the causes of many peculiarities in the pictures obtained by Seitz and Harig [see Abstract 1428 (1930)] when using medium velocity electrons impinging on photographic plates. R. C. F.

605. Determination of e/m for an Electron by Direct Measurement of the Velocity of Kathode Rays. Charlotte T. Perry and E. L. Chaffee. *Phys. Rev.* 36. *pp.* 904–918, *Sept.* 1, 1930.—The velocity of kathode rays, driven by potentials of from 10,000 to 20,000 volts, is measured directly by timing the passage of the electrons between two localised transverse h.f. electric fields 75 cm. apart. Those electrons which pass undeflected travel the distance between the deflecting fields in an even multiple of half a cycle of the oscillating fields. The velocity thus obtained, combined with the expression for the energy imparted to an electron in falling through a measured difference of potential, gives the value of e/m_0. The mean value thus obtained is $e/m_0 = (1\cdot761 \pm 0\cdot001) \times 10^7$ e.m.u./gm. This value is in agreement with the values obtained by spectroscopic methods and does not agree with the most accurate previous value obtained for free electrons. A possible explanation for the discordant value previously obtained for free electrons is given. AUTHORS.

606. Reflection of Kathode Rays from Bent Mica. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 203–212, *Sept.*, 1930. *In English.*—Using monochromatic kathode rays of energy between 14–63 kV, more than eleven lines have been recorded on the spectrogram corresponding to different orders of reflection from the cleavage face of mica. The simple Bragg law does not hold. Attributing the deviation to the refraction of the rays by mica, the inner potential has been calculated to be 10·6 volts. F. J. W.

607. Visible Electron Streams. E. Brüche and W. Ende. *Zeits. f. Physik,* 64. 3–4. *pp.* 186–190, 1930.—A method is described of producing fine visible streams of slow electrons, which may attain lengths up to 1 m. Various cases of magnetic deflection are described, and the possibilities of scientific and technical application are indicated. F. S.

608. Theory of Scattering of Slow Electrons in Gases. H. Bartels and H. Noack. *Zeits. f. Physik,* 64. 7–8. *pp.* 465–498, 1930.—By suitable limitation of conditions the theory of scattering is given in a form which, without being very complicated, is nevertheless sufficiently general to take account of all the factors concerned and is capable of application to special experimental problems. A number of examples are then given of the application of the theory to the investigation of particular methods of research on electron impacts. The examples include Pose's work [see Abstract 914 (1929)], measurements of the excitation function by Hanle [see Abstract 3336 (1929)] and by Elenbaas [see Abstract 2181 (1930)], dependence of intensity on pressure in measurements of the excitation function, raising of the number of impacts by the presence of other gases, and the methods of Ornstein and Elenbaas for the optical measurement of effective cross-section [see Abstract 2182 (1930)]. Investigation of these methods shows that in all of them factors have been neglected which may appreciably affect the results. [See Abstract 3391 (1929).] A. W.

609. Scattering of Fast Electrons by Metals. Part I. Sensitivity of the Geiger Point-Discharge Counter. C. T. Chase. *Phys. Rev.* 36. *pp.* 984–987, *Sept.* 1, 1930.—This paper presents new information on the sensitivity of the Geiger point-discharge counter. The type of counter used here, with a cylindrical chamber, the open end being covered with thin foil, is not sensitive to electrons of all velocities at the same time. The velocity sensitivity depends on the voltage applied to the counter, higher velocities being registered at higher voltages. This information may have an important bearing on past experiments looking for electron polarisation. AUTHOR.

610. Scattering of Fast Electrons by Metals. Part II. Polarisation by Double Scattering at Right Angles. C. T. Chase. *Phys. Rev.* 36. *pp.* 1060–1065, *Sept.* 15, 1930.—The present paper concerns a search for polarisation by double scattering at right angles, using radium E as a source, and a sensitive gold leaf electroscope to detect the arrival of the scattered electrons, the slower electrons being eliminated from the experiment. A peculiar type of polarisation appears, which can be described as follows, using the notation of previous papers. At moderate electron speeds the number counted in the configuration called 0° is greater than the number counted at 180°. This effect does not appear for very slow electrons. As the speed of the electrons approaches that of light, the above type of polarisation persists, and another type appears, superposed upon the first; the number counted at 270° becomes greater than the number counted at 90°. Previous experiments of a similar nature, in which one or the other of the above effects appears, are discussed. AUTHOR.

611. Angle and Energy Distribution of Electrons Scattered by Helium, Argon and Hydrogen. J. H. McMillen. *Phys. Rev.* 36. *pp.* 1034–1043, *Sept.* 15, 1930.—The distribution of electrons rebounding at definite angles from gaseous molecules was investigated. An electrostatic re-focussing arrangement was used to analyse the energies of the electrons. In helium, it was possible to identify the following energy losses at several angles, 21·12, 22·97, and 23·62 volts for a primary electron beam of 50 volts, but not the 19·77 and 20·55 volt losses. The number of electrons, rebounding without loss of energy, was measured for different angles of rebound (7° to 60°) from argon, helium and molecular hydrogen molecules, and for various energies (50 to 150 volts). A scattering curve was also obtained in helium for 100-volt electrons that had lost 21·12 volts energy. In almost all cases the number scattered decreased rapidly as the angle increased. The higher the energy of the electrons the more rapidly did the number fall off with increasing angle. The steepness of the curves increases as we go from argon to helium to hydrogen for the slower electrons. For the faster electrons their curves are practically superposable. The results were compared with those of other observers and with the theoretical predictions of Mott, Mitchell and Sommerfeld. AUTHOR.

612. Ionisation of Gases by Short-Wave X-Rays. K. Schocken. *Zeits. f. Physik*, 64. 7–8. *pp.* 458–464, 1930.—By a method similar to that used by Fricke and Glasser, the contribution of the photoelectrons and the recoil electrons to the ionisation produced by X-rays was measured. Spectrally resolved rays were used and gaseous substances examined. Above 0·350 Å. the recoil electrons yield only a very small contribution to the total ionisation. This result is of importance as regards the question of the dependence on wave-length of the scattering coefficient. J. J. S.

613. Mobility of Ions in Pure Gases. A. M. Tyndall and C. F. Powell. *Roy. Soc., Proc.* 129. *pp.* 162–180, *Sept.* 3, 1930.—Employs a modification of the apparatus used by the authors and Starr in experiments on nitrogen. Determinations of the mobility of ions in dry air were made in the first place at different pressures, and the results obtained seem to confirm the reliability of the apparatus, which had no wax joints, and could be subjected to a rigorous heat treatment. Results in nitrogen emphasised the great importance of small traces of impurity on the mobility of positive ions. The negative ions were all electrons. The absence of " normal " negative ions is not an adequate criterion of purity. In helium the maximum mobility was of the order of 17; slight contamination on standing transformed the ions into a mixture of groups, differing widely in mobility, with a maximum at 10; this went down to about 9 when vapours of mercury and tap grease were allowed to enter the apparatus. The effect of impurities is to be expected from the principle of electron capture discussed by Kallmann and Rosen in a recent paper. To get the true mobility of the ion in its own gas the residual impurity should be reduced to the order of a few parts in a million. No significance can be attached to the mobilities of the positive ions previously obtained in any of the ordinary gases. H. N. A.

614. Behaviour of Positive Ions in Hydrogen. A. C. G. Mitchell. *Frank. Inst. J.* 210. *pp.* 269–286, *Sept.*, 1930.—Lithium and cæsium ions of various velocities are produced in a tube containing hydrogen and the rate of decrease of pressure is measured. This rate is greater when ions are flowing then in their absence, indicating the formation of a condensible product due to the action of the ions. From 0·01 to 0·5 hydrogen molecules disappear for each ion entering the tube. No difference was found between lithium and cæsium ions, nor are there any critical potentials between 15 and 320 volts. J. H. A.

615. Electron Exchange for Slow Ions. H. Kallmann and B. Rosen. *Zeits. f. Physik*, 64. 11–12. *pp.* 806–816, 1930.—The transfer of electrons from rapidly moving ions to neutral molecules with consequent production of slow ions, previously demonstrated by absorption measurements [see Abstract 2639 (1930)], has now been subjected to test by a direct method. A beam of fast-moving ions selected out by means of the mass spectrograph was passed into a chamber containing gas at variable pressure, and entered finally a Faraday cylinder. A wire introduced near to, but not in, the path of the ion beam, was raised to a small potential insufficient to affect the main beam of ions, but large enough to collect any slow ions produced by electron interchange between fast ions and molecules of the gas. The results show as before a definitely selective effect when certain ions are used with certain gases. Special attention was given to the electron interchange between singly and doubly charged argon ions, and neutral argon atoms. W. S. S.

616. Photoelectric Cells and their Applications. *Optical Soc., Trans.* 31. 4. *pp.* 233-240, 1929–1930.—A discussion at a Joint Meeting of the Physical and Optical Societies, June 4 and 5, 1930, at which the following papers were presented: " Early History of Photoelectric and Selenium Cells," by **H. S. Allen**; " Theory of Selective Photoelectric Emission," by **N. R. Campbell**; " Standardisation of Photoelectric Cells," by **N. R. Campbell**; " Manufacture, Properties, and Use of Sodium Photoelectric Cells," by **P. Selényi**; " Manufacture and Use of the Thin-Film Cæsium Cell for Sound Reproduction," by **L. J. Davies** and **H. R. Ruff**; " Barium

Photoelectric Cells," by **T. W. Case**; "Manufacture of Photoelectric Cells and their Use in Sound Reproduction," by **D. H. Loughridge**; "Photoelectric Cells and some Applications," by **J. Kunz**; "Time-Lag in Gas-Filled Photoelectric Cells," by **N. R. Campbell** and **L. G. Stoodley**; "Complete Electrostatic Method for Measurement of Photoelectric Currents," by **E. B. Moss**; "Method of Comparing very Small Amounts of Light by Means of a Photoelectric Cell and a Valve Amplifier," by **G. M. B. Dobson** and **D. S. Perfect**; "Theory of Use of a Photoelectric Cell with a Valve Amplifier," by **N. L. Yates-Fish**; "Theory of Amplification of Photoelectric Currents by Means of Valve Amplifiers," by **H. A. Thomas**; "Distortion in the Amplification of Photoelectric Currents and a Remedy," by **H. Geffcken** and **H. Richter**; "Method of Measuring Small Angles," by **D. S. Perfect**; "Photoelectric Photometry," by **C. H. Sharp**; "Photoelectric Cell as a Precision Instrument in Photometry," by **T. H. Harrison**; "Photoelectric Measurement of Daylight," by **W. R. G. Atkins** and **H. H. Poole**; "Photoelectric Integrating Photometer," by **A. S. G. Hill**; "Neon Discharge Tube Photometer," by **J. H. J. Poole** and **H. H. Poole**; "Photoelectric Cell as Essential Part of Recording Micro-Photometer," by **P. P. Koch**; "Factors Affecting the Speed of the Koch Micro-Photometer," by **E. A. Baker**; "Use of Photoelectric Cell in Spectrophotometry," by **K. S. Gibson**; "Spectrophotometric Absorption Measurements," by **D. S. Perfect**; "Spectrophotometer for Measuring Amount of Ozone in the Upper Atmosphere," by **G. M. B. Dobson**; Use of Photoelectric Cells in Biological Work," by **V. E. Shelford**; "Photoelectric Photometry in Relation to Phototherapy," by **H. D. Griffith**; "Selenium Cells and their Use in Sound Film Reproduction," by **H. Thirring**; "Manufacture of Selenium Cells," by **C. E. S. Phillips**; "Infra-Red Sensitive Cells," by **F. Schröter** and **F. Michelssen**; and "The 'Thallofide' Cell," by **T. W. Case**.

617. Manufacture of Photoelectric Cells. G. Déjardin. *Rev. d'Optique*, 9. *pp.* 337–352, *Sept.*, 1930.—The modern processes of the manufacture of photoelectric cells are described, and the many difficulties encountered, such as suitable glass, vacuum technique, manipulation of alkaline metals and pure gases, are pointed out. As regards the bulbs, which vary greatly in shape, these are preferably made of pyrex glass. The preparation of the kathodic base is considered and there is a careful examination of the problem of the extension of the sensibility towards the great wave-lengths of the visible spectrum. This sensibility in certain cases is illustrated by curves, and the results obtained from the employment of photosensitive kathodes with monomolecular bases are demonstrated. The paper is scarcely suitable for a short abstract and should be referred to. T. C. H.

618. Space Distribution of X-Ray Photoelectrons from a Solid Film. L. Simons. *Phil. Mag.* 10. *pp.* 387–401, *Sept.*, 1930.—Using the method of the retarding electric field, the author has confirmed the result arrived at by Auger and Perrin that the probability of ejection of a particle in a given direction is proportional to the square of the cosine of the angle between this direction and that of the electric vector in the light producing it. [See also Abstract 273 (1929).] J. J. S.

619. Influence of Gas Pressure on the Photoelectric Conductivity of Organic Dyestuffs. A. Petrikaln. *Zeits. f. phys. Chem.* 10. *Abt. B.* 1. *pp.* 9–21, *Sept.*, 1930.—By observations with thin layers of dyestuffs of the triphenylmethane series, it has been established that the photoelectric conductivity is dependent on the nature and pressure of the gaseous environment. For the majority of dyes examined, this conductivity increases with decrease of gas pressure. Oxygen has been found to inhibit the conductivity most and hydrogen least. The reverse effect was exhibited by the phthaleins and especially eosine and erythrosine, where the photoelectric effect increases with the pressure and is promoted most by oxygen and least by hydrogen. If the assumption be made that the photoelectric conductivity in one case is inversely and in the other directly proportional to the amount of absorbed gas, then the data are in fairly good agreement with the Freundlich absorption formula. H. H. Ho.

620. Oscillation Problems. W. Gauster. *Archiv f. Elektrot.* 24. *pp.* 360–382, *Sept.* 27, 1930.—A mathematical paper on the solution of oscillation problems by means of symbolic differential calculation. J. J. S.

621. H.F. Measurements by the Barretter Method. M. Wien. *Phys. Zeits.* 31. *pp.* 793–797, *Sept.* 1, 1930. *Paper read before the Deut. Phys. Gesell., Halle, June,* 1930.—In the barretter method of investigating alternating currents, the current is sent through two branches of a circuit, in which currents I_1, I_2 flow respectively. By suitable coupling, these currents affect the two arms of a barretter bridge, the balance in which is disturbed unless $I_1 = I_2$. The method is thus a null method depending on the equality of two currents of considerable strength and not, as in the Wheatstone bridge, on the vanishing of a current. By variation of I_2 with respect to I_1 the galvanometer deflection can be made to pass from positive through zero to negative values. In dealing with inductances, compensating capacities are introduced into the circuit arms, and *vice versa,* so as to satisfy the condition $\omega^2LC = 1$, only the real part of the resistance operator then remaining. For very high frequencies the method is not practicable on account of difficulties in screening from capacitative and inductive coupling and on account of the difficulty of making the two circuit arms exactly equal to one another, but good results may be obtained for moderate frequencies. It is possible to apply the method to current surges as well as to damped or undamped continuous waves. The paper concludes with a discussion of practical details concerning both apparatus and operation of the method. A. W.

622. Mutual Inductance and Repulsion of Two Adjacent Disc Coils. H. B. Dwight and T. Y. Lu. *J. Math. Phys., Mass. Inst. of Technology,* 9. *pp.* 315–319, *Sept.,* 1930.—Formulæ for the mutual inductance and electromagnetic force between two very thin disc-shaped coils placed coaxially are derived on the basis of a formula given by Maxwell for two coaxial circles, and extended by Rosa and Cohen. The equation for electromagnetic forces was checked experimentally, and it was found that the calculated force was some 10 % less than the measured value. G. E. B.

623. Magnetic Characteristic of the Iron Crystal. W. Gerlach. *Zeits. f. Physik,* 64. 7–8. *pp.* 502–506, 1930.—The present state of knowledge of the magnetic properties of single crystals of iron is considered, particularly with reference to those of the more recent experiments which are not in agreement with the experiments of the author. It is concluded that the coercive force tends to decrease without limit as the purity of the crystal increases, and that it provides a measure of the internal stresses.

No positive conclusions can yet be reached about the residual magnetism in single crystals. J. H. A.

APPARATUS AND INSTRUMENTS.

624. A.C. Galvanometer. H. Mukherjee. *Zeits. f. Physik,* 64. 3–4. *pp.* 286–291, 1930.—A suspended-coil form of wattmeter, provided with a reflecting mirror, as suggested by Maxwell, is described. The galvanometer, which is very much more sensitive than the type of telephone customarily employed for the purpose, is suitable for the determination of electrolytic resistances, etc., and permits an accuracy of 1 part in 2000 being attained when a current of 0·025 ampere flows in the coils. J. S. G. T.

625. Apparatus for Measuring High Constant or Rippled Voltages. L. S. Taylor. *Bureau of Standards, J. of Research,* 5. *pp.* 609–618, *Sept.,* 1930.—An improved form of high resistance to be used as a high-voltage voltmeter multiplier for use up to 150 kV is described. The total resistance is 100 megohms, designed to be coronaless by placing 100 1-megohm resistors in 20 corona cases containing 5 resistors each, the corona cases being mounted in series on top of each other. The complete unit is readily portable. Methods of calibrating the resistance under full-load conditions are described. Errors are discussed and necessary corrections, to give a maximum error in high-voltage measurement of 0·01 %, are given. A new type of high-voltage string electrometer for use in connection with the resistance is also described. AUTHOR.

626. Electrical Characteristics of Commercial Mercury Arcs. L. J. Buttolph. *Rev. Sci. Instruments,* 1. *pp.* 487–506, *Sept.,* 1930.—An analysis of the main characteristics of various types of mercury-vapour arcs. Among the curves given are the starting and operating curves, regulating characteristics and energy distribution curves for arcs of the " Uviol " and Cooper-Hewitt types, and various oscillographic records of the rectifying action of Cooper-Hewitt arcs. It is concluded that none of the extraneous factors (such as supply voltages, stability, or kind of cooling) affect the radiation characteristic of the arc itself, and the specification of arc current and voltage is all that is necessary to duplicate the performance, provided suitable data regarding the type of arc are given. G. E. B.

627. Design and Operation of Vacuum Furnaces with Carbon Resistor Tubes. A. S. King. *Am. Electrochem. Soc., Trans.* 56. *pp.* 97–110, 1929.—The two types of electric vacuum furnaces described are the result of years of study on rendering metallic vapours luminous by " temperature radiation." High temperatures alone appear to be necessary to produce the large variety of spectroscopic phenomena observed. No definite type of chemical action has appeared to be necessary. The cylindrical and the hooded types of graphite resistor-tube furnaces each have a temperature range up to 3500° C. Steady conditions of temperature and pressure are quickly reached, after which the light is permitted to pass to the spectrograph. An image of the interior of the tube is projected on the slit, light from the incandescent wall of the tube being excluded. The charge in the tube is vaporised, and the characteristic radiations of the vapour excited under close control of conditions. A long column of uniformly heated vapour is obtained. Various spectroscopic studies are briefly described. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

628. Electrical Impulse Rate Indicator and Recorder. W. W. Macalpine. *Rev. Sci. Instruments,* 1. *pp.* 523–526, *Sept.,* 1930.—A circuit is described which is operated by impulses and in which the reading of a meter is a function of the rate of the impulses. In the present instance the impulses operate a Weston Model 30 galvanometer relay whose contacts discharge a condenser. The condenser is charged up again through a resistance after each impulse, and a microammeter reads the average voltage across the resistance. A smoothing circuit is used between the microammeter and the resistance. Variations of the device may be used according to the nature of the impulses. A Leeds and Northrup recording potentiometer may be attached to the device to obtain a continuous record of the rate. In another form, the average voltage may operate on the grid of a tube, the plate current of which operates a more rugged indicating meter than the microammeter. This also simplifies the filter circuit. Means for calibrating the device are discussed. AUTHOR.

629. Heating of Electrolytes in H.F. Fields. J. C. McLennan and A. C. Burton. *Canad. J. of Research,* 3. *pp.* 224–240, *Sept.,* 1930.—In this investigation the heating of solutions of simple electrolytes of varying concentrations when irradiated by short electromagnetic waves from 10 to 200 m. in length was measured. It was found that for a given wavelength there is a maximum heating effect produced in a medium, the specific conductivity and dielectric constant of which are connected with the frequency by a simple law. This law, proved theoretically as well as shown experimentally to hold for dilute solutions, is $\frac{2C}{nK} = 1$, where C = specific conductivity in absolute units, K = dielectric constant and n = frequency of wave. "Skin effect" was shown theoretically and experimentally to be negligible for substances having the low conductivities studied and deep-seated heating effects were shown to be attainable with the radio waves used. The possibility of directed selective heating effects is suggested and illustrated by experiments on blood. The law shown to apply in these experiments was used to evaluate the dielectric constant of water. AUTHORS.

630. Heating of the Electrolyte in H.F. Condensers, and its Application to Medicine. J. Pätzold. *Zeits. f. Hochfrequenztechn.* 36. *pp.* 85–98, *Sept.,* 1930.—An experimental investigation into the warming of the electrolyte using two different arrangements: (1) the electrode within the electrolyte and (2) the electrode outside the electrolyte and separated from it by a dielectric layer. Special reference is made to electrolytes of biological importance (*e.g.,* serum and blood), and the frequencies for maximum heating are worked out according to formulæ derived experimentally. G. E. B.

631. Penumbral Shadows and their Significance in Radiography. P. M. Andrus. *Canad. J. of Research,* 3. *pp.* 252–259, *Sept.,* 1930.—A new observation regarding the visual characters of penumbral shadows is recorded. It is pointed out that penumbral shadows appear to be laid down as a series of bands arranged serially as to density. This occurrence results in far-reaching effects in radiography as well as in other sciences concerned with the observation of images. AUTHOR.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

632. Theory of Adsorption. A. Ganguli. *Ziets. f. Physik*, 64. 1–2. *pp*. 81–83, 1930.—A comparison of the adsorption isotherms of the author [see Abstract 2945 (1930)] and Sexl [see Abstract 2515 (1928)] shows that they are essentially the same equation. F. J. W.

633. Antonow's Rule and Molecular Orientation. N. Fuchs. *Kolloid Zeits*. 52. *pp*. 262–269, *Sept.*, 1930.—Deviations (Δ) from Antonow's rule have been calculated by means of the equation $\Delta = \sigma_0'(1 - \cos\beta) + \sigma_{w0}(1 - \cos\alpha)$, where σ_0' is the surface tension of the liquid in equilibrium with water saturated therewith, σ_{w0} the interfacial tension, $\pi - \alpha$ the angle made by the water surface with the under surface of the floating lens of fluid under examination, $\pi - \beta$ that with the upper surface. α is determined experimentally at 20°, β usually calculated from the relation $\sin\beta/\sin\alpha = \sigma_{w0}/\sigma_0'$. Spreading coefficients have also been determined. Forty-five organic liquids have been examined with results agreeing with those found by Harkins [see Abstract 1028 (1929)] so far as the latter go. They show Antonow's rule to be valid in 29 cases. For comparison purposes as a measure of the deviation therefrom, $\Delta/\sigma_{w0} = \theta$ is used. The values of θ show distinct connection with molecular structure, θ being a maximum for normal, less for secondary, alcohols and acids, and least for tertiary alcohols, ketones, ethers, esters and hydrocarbons. α has also been determined in three cases for other temperatures. The cause of the deviations is discussed, and considered to be connected with varying degrees of orientation of the molecules in the saturated adsorption layer. C. A. S.

634. Exchange of Energy (in Vacuo) Between Gas, Solid and Adsorbed Layer. Part I. Method of Detecting Variations in the Thermal Efficiency of Molecular Collisions. Part II. Effect of a Deposited Monomolecular Layer on the Efficiency of Molecular Collisions. M. C. Johnson. *Roy. Soc., Proc.* 128. *pp*. 432–444, and 444–451, *Aug*. 5, 1930.—In Part I an experimental arrangement, sensitive to small changes in the "accommodation coefficient," α, for hydrogen at the glass surface of a vacuum apparatus is described, and applied to tracing a 20 % change in a function of α, as the surface is progressively freed from adsorbed vapour. In Part II the method described in Part I is extended to determine the change in α for Hα, when a hydrogen layer of monomolecular thickness has been deposited on the glass. The experiments isolate the purely physical part of the changes in α which accompany the formation of such active monomolecular layers as are discussed in the chemistry of heterogeneous reactions, and show that the variation of α agrees with the hypothesis that, in these experiments, elastic collision is the principal mechanism of energy exchange, and that not only the H_2 but also the H_2O molecules form monomolecular attachments to the solid lattice. [See Abstracts 899 (1911) and 1101 (1916).] J. S. G. T.

635. Interior and Superficial Structure of Organic Liquids. J. J. Trillat. *Zeits. f. Physik*, 64. 3–4. *pp*. 191–213, 1930.—This paper describes an X-ray investigation of organic liquids wherein possibilities of error due to surface walls, etc., are avoided, certain appropriate fatty acids, alcohols and triglycerides being chosen. The results of Stewart, Morrow and Katz have been reproduced and certain molecular association phenomena have been established. The surface structure has been investigated by a drop method and in certain cases an average orientation of the molecules perpendicular to the free surface has been proved, an orientation which gradually disappears with distance from the surface. The approximate molecular dimensions have also been calculated and are in accord with the above perpendicular orientation. The diffraction method proved to be inapplicable in certain cases. H. H. Ho.

636. Dineric Distribution. Part I. Distribution of a Consolute Liquid Between Two Immiscible Liquids. D. B. Hand. *J. Phys. Chem.* 34. *pp.* 1961–2000, *Sept.*, 1930.—When ternary systems of one consolute and two immiscible liquids are plotted with properly selected units for one of the immiscible liquids, the tie-lines become horizontal, so that knowledge of the isotherm and one tie-line renders it possible to predict the compositions of all pairs of conjugate phases. This horizontality is equivalent to the distribution equation $\frac{a_1}{b_1 + \mathrm{K}c_1} = \frac{a_2}{b_2 + \mathrm{K}c_2}$ (a, b and c are grams of consolute liquid and of the immiscible components respectively, and the subscripts denote upper and lower phases), which accounts for the increasing solubility of the immiscible liquids and holds well for concentrated, but not so well for very dilute solutions. None of the four cases studied support the simple form of the Nernst distribution equation and only by assuming association of the consolute liquid in one phase is it possible to make the distribution of acetic acid between chloroform and water apparently obey the Nernst law up to concentrations of 1 % of acetic acid in chloroform. All cases so far investigated for dineric distribution in high concentration follow the empirical equation $\left(\frac{b_1}{c_1}\right)^m : \left(\frac{c_2}{a_2}\right) = \text{constant}$, from which, together with the equation given above, the composition of a second phase may be calculated when that of the first phase is known. The isotherm for saturated solutions of benzene, water and acetic acid does not follow the mass law equation, $\log\left(\frac{b}{a}\right) + n \log\left(\frac{c}{a}\right) = \log \text{const.}$ The theoretical validity of the three equations given is discussed. T. H. P.

637. Measurements of Suspensions and of Deposits. P. Mercier. *J. de Physique et le Radium*, 1. *pp.* 292–305, *Sept.*, 1930.—A cylindrical float was used, suspended by a hair from one end of an astatic balance. The upper surface of the float started at or above the surface dividing the suspension from the pure water above it, and the float was just balanced by the weight of the liquid it displaced, including the suspended particles. As the particles settled the float followed them, and the bottom of the float was always in contact with the same horizontal layer of particles as at the commencement, so that the velocity of this layer could be observed. An arrangement is also described which can be used to study a heterogeneous suspension containing a number of sizes of particles, which number may be small or very large (infinite). In this the float is held by the balance near the surface of the liquid, which is well stirred, so that the particles are evenly distributed. As the particles descend the larger ones move more rapidly than the smaller ones, so that the buoyancy of the float is lost, rapidly at first, and more gradually finally, as the smaller particles fall below the level of the float. Conclusions can be drawn as to the relative numbers of particles of different sizes present from the curve showing rate at which the buoyancy is lost. Methods of studying the deposits formed are mentioned. H. N. A.

638. Action of Colloids in Precipitating Fine Grained Sediments. P. G. H. Boswell. *Geolog. Mag.* 67. *pp.* 371–381, *Aug.*, 1930. *Abstract of paper read before the British Assoc., Capetown,* 1929.—It is pointed out that when unconsolidated samples of marine sediments are shaken up with sea-water at ordinary temperatures, even through a fall of only four inches, settlements settle out roughly according to their grade-composition. Furthermore, the material at the bottom of a vessel is clearly differentiated according to size. Sand occurs below, silt above and clay at the top. Factors determining rate of subsidence of the grain occurring in sedimentary rocks are gravity, the influence of electrolytes and co-precipitation of colloids. The results of experimental work are given for sedimentation in sea-water, tap-water and distilled water at 18° C. and 25° C. The geological bearing of this experimental work is also discussed. J. K.

639. Dielectric Constants of Gold and Mercury Sols. A. Piekara. *Kolloid Zeits.* 52. *pp.* 179–184, *Aug.*, 1930.—An improved procedure for the preparation of mercury sols by the thermic method is described, and results are given of measurements, by means of a highly sensitive resonance method, of the difference between the dielectric constants of certain gold and mercury sols and those of the pure dispersion media. The results are not in agreement with those of Keller, the dipole effect being not greater than 0·1 [see Abstract 1213 (1930)]. T. H. P.

640. Photoelectric Determination of the Relation Between Number and Dimensions of Particles and the Magnitude of the Light Dispersion. N. N. Andrejew, N. A. Kudrjawzew and T. A. Stessel. *Kolloid Zeits.* 52. *pp.* 184–189, *Aug.*, 1930.—Since no absolute measurements of the dispersion of light can be made, it is not possible to determine the constant of Rayleigh's equation, $I = Knv^2/\lambda^4$, in which I is the dispersion, n the number of particles, v the volume, λ the wavelength of the light, and K a constant. The experiments now described were made with (1) colloidal solutions of colophony with the particle radius $0{\cdot}146$–$0{\cdot}163\mu$; (2) emulsions of staphylococcus of radius about $0{\cdot}38$–$0{\cdot}42\mu$; (3) suspensions of spores of penicillium of radius $1{\cdot}85$–$1{\cdot}91\mu$; (4) suspensions of spores of trichophyton gipsum asteroides of radius $1{\cdot}96$–$2{\cdot}04\mu$. The particles present were counted and measured, and the light dispersion also measured. For materials (2), (3) and (4) the numbers of particles of the separate emulsions are proportional to the dispersion and the mean value of K is $5{\cdot}32 \times 10^{-18}$, the deviations from the mean never exceeding 3·6 %. With colloidal colophony solutions the dispersion increases rather more rapidly than the number of particles present, probably owing to increase in the degree of dispersion on dilution. These solutions differ from the bacteria and fungus spore suspensions in that they effect a true dispersion of the light; the mean value of K is $3{\cdot}98 \times 10^{-16}$. T. H. P.

641. Viscosity Anomalies in the Flow of Colloids. H. Kroepelin. *Zeits. f. phys. Chem.* 149. *Abt. A.* 4. *pp.* 291–330, *Aug.*, 1930.—The velocity distribution of an abnormal gelatin solution flowing through a straight tube of circular cross-section has been measured directly and found to deviate from that of a normal liquid in the manner anticipated, strata flow being in evidence. Gelatin solutions which do not exhibit viscosity anomalies afford a parabolic velocity distribution like normal viscous fluids. H. H. Ho.

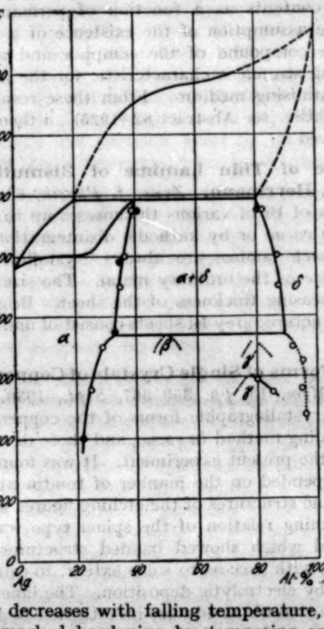
642. Structure of Celluloid. Part I. Change of the Optical Anisotropy on Stretching of Camphor-Celluloid with varying Camphor Content. J. C. Derksen, J. R. Katz, K. Hess and C. Trogus. *Zeits. f. phys. Chem.* 149. *Abt. A.* 5. *pp.* 371–381, *Aug.*, 1930.—Results of a study of the variation of the anisotropy of celluloid with various camphor contents as a function of permanent stretching are explainable on the assumption of the existence of a negatively, doubly refracting additive compound of the camphor and nitrocellulose. The diagram of limiting stretch is characteristic for the action of the nitrocellulose as a gelatinising medium. From these results, in conjunction with those of Wächtler [see Abstract 82 (1925)], a theory of the structure of celluloid is derived. T. H. P.

643. Structure of Thin Laminæ of Bismuth. W. Büssem, F. Gross and K. Herrmann. *Zeits. f. Physik*, 64. 7–8. *pp.* 537–546 1930.—Thin sheets of Bi of various thicknesses up to 6μ were produced by vaporisation *in vacuo* or by kathodic disintegration in hydrogen. It was found that such laminæ are always crystalline. They have the rhombohedric lattice of the ordinary metal. The size of the crystallites increases with increasing thickness of the sheet. Bright Bi sheets have a simple fibrous structure: grey Bi sheets consist of undirected crystallites. J. J. S.

644. Crystal Forms of Single Crystals of Copper. S. Takeyama. *Kyoto Coll. Sci., Mem.* 13. *pp.* 353–367, *Sept.*, 1930. *In English.*—In Part I the outer crystallographic forms of the copper crystals obtained by the stress-annealing method *in vacuo*, and those developed by etching, were examined in the present experiment. It was found that the crystal faces developed depended on the manner of treatment of the surface of the crystal. The fine structures of the etching figures were also observed. Polysynthetic twinning relation of the spinel type was detected in the part of the crystal which showed banded structures. In Part II an attempt was made, with success to some extent, to cause a single crystal of copper to grow by electrolytic deposition. The inner and outer structures of the crystals thus obtained were investigated Roentgenographically and optically. It was observed that, under favourable conditions, the deposited copper consisted of a nearly perfect single crystal of the same orientation as that of the mother crystal at an early stage of deposition. As the deposition process proceeded, however, the deposited copper was found to consist of microcrystals having the orientations scattered more or less from that of the mother crystal. AUTHOR.

645. X-Ray Investigations on Copper-Arsenic Alloys. N. Katoh. *Chem. Soc. Japan, Bull.* 5. *pp.* 275–282, *Sept.*, 1930. *In English.*—Alloys of copper and arsenic containing up to approximately 30 % of arsenic have been subjected to an X-ray analysis. Arsenic is soluble in copper to a saturation concentration of about 4 %. The edge of the unit cell of copper increases from 3·608 Å. to 3·640 Å. as one proceeds from pure copper to copper containing 4 % of arsenic. A β-phase exists which is homogeneous over the concentration range 28·6–29·6 %. The dimensions of the elementary cell of this phase have been determined. There appear to be six molecules of CuAs to the unit cell. F. J. W.

646. Silver-Platinum System: Crystal Structure, Electrical Properties and Temper-Hardening in Relation to the Equilibrium Diagram. C. H. Johansson and J. O. Linde. *Ann. d. Physik*, 6. 4. *pp.* 458–480, *Sept.* 4, 1930.—Measurements of electrical resistance and thermoelectric force and X-ray analysis of the crystal structure of heat-treated specimens establish the extent of the interruption in the solid solubility of platinum and silver. The range of solid solubility of each metal in the other decreases with falling temperature, consequently it is possible to effect marked hardening by tempering specimens quenched from higher temperatures. Below 750° C. there is evidence of three, and possibly four, new homogeneous fields. The changes in ductility with heat-treatment and the relative stability of the disperse phases precipitated from solid solution under different conditions are discussed. [See also Abstract 4131 (1930).] A. J. M.



647. Relation between Plasticity of Crystals and Temperature. Part II. W. Fahrenhorst and E. Schmid. *Zeits. f. Physik*, 64. 11–12. *pp.* 845–855, 1930.—Continues with zinc the observations recorded in Part I by Boas and Schmid [see Abstract 3276 (1930)] on Cd, the constant energy of slip on breaking observed with Cd has been found approximately for Zn. Experiments made at very low temperatures show, instead of an increase in hardness due to slip (*Verfestigung*), that the hardness diminishes (*Entfestigung*). The latter was observed at 20° K.

and at 88° K.; at temperatures below 191° K. the breaking of the crystal takes place by splitting along the basal plane. H. N. A.

648. Corrosion Rate of Ferro-Nickel Alloys. C. G. Fink and C. M. DeCroly. *Am. Electrochem. Soc., Trans.* 56. *pp.* 239–273; *Disc.*, 273–277, 1930.—A series of tests was made on the rate of corrosion of commercial iron-nickel alloys. The method of measurement of rate of corrosion was the intermittent corrosion test, in which the specimen was exposed to the action of the corrosive agent and to the air for a definite period of time. Solutions of sulphuric acid of different concentrations were used as the corrosive agent. The influence of reagents causing the metals to assume the passive state was determined. It was shown that when the intercrystalline areas were more soluble than the crystals themselves, the whole alloy was weakened in spite of the high corrosion resistance of the crystals themselves. F. J. B.

649. Chemical Methods of Anti-Corrosive Treatment of Metals and Alloys. J. Cournot and J. Bary. *Rev. de Mét.* 27. *pp.* 479–485, *Sept.*, 1930.—Describes tests of samples of steel after "parkerisation" in hot baths of various phosphates and mixtures of phosphates, together with free phosphoric acid; the commencement of the attack by a salt mist began in the times recorded, and the relative weights lost in 460 hours are also given: untreated steel, 1 h. 30, 2143; treatment with phosphate of iron alone, 5 h. 30, 743; phosphate of zinc alone, 8 h. 00, 132; phosphate of manganese alone, 22 h. 30, 179; mixture of phosphates of iron and zinc 22 h. 30, 120; mixture of phosphates of zinc and manganese, 70 h. 00, 115; mixture of phosphates of manganese and iron, 70 h. 00, 198. The mixtures are clearly better than the simple phosphates. The treated metal is "finished" in practice by various lacs, fats or oils, and the effect of these on the corrosion has been studied. The crystals of phosphates are extremely dense and interlaced; and, since at first the phosphoric acid attacks the steel, the phosphates are deposited in the joints of the crystals of iron, the result being that the layer is very firmly attached to the metal. The process can be shortened by a short preliminary treatment in a bath containing the phosphates of iron and manganese, silicic acid and certain phosphosilicates, which act as catalysers. A new method of protecting aluminium and light alloys is also mentioned. It uses salts of metals having two oxides, that with less oxygen being insoluble. The soluble oxide is first deposited, and is then reduced to the insoluble oxide by means of nascent hydrogen. H. N. A.

650. Insoluble Sulphates and Passivity. L. McCulloch. *Am. Electrochem. Soc., Trans.* 56. *pp.* 325–328; *Disc.*, 328–332, 1929.—Iron, nickel and chromium have anhydrous sulphates which go into solution with difficulty. These sulphates may compose the films which cause the passivity of these metals in sulphuric acid. Cobalt and chromium anodes dissolve readily because they have easily soluble anodic products. It is suggested that any slowly soluble anode product may be the cause of passivity. AUTHOR.

651. Passivity of Metals. Part VI. Penetrating Powers of Anions. S. C. Britton and U. R. Evans. *Chem. Soc., J. pp.* 1773–1784, *Aug.*, 1930.—The penetrating power of different anions is compared by measurement of the leakage current at an aluminium anode with potassium chromate as a film-producing solute. The initial current is found to be influenced by the pre-treatment of the metallic surface, but the final constant value is almost independent of pre-treatment. Fluctuations are found which are due to the alternate breakdown and repair of the anode film, and the results explain why reproducibility is good in some conditions, and poor in others. F. J. B.

652. Tautomerism and Related Phenomena from the Standpoint of the Electronic Theory of Valency. L. Kowarski. *Zeits. f. phys. Chem.* 9. *Abt. B.* 3. *pp.* 173–200, *Aug.*, 1930.—Some typical bond relationships of organic and inorganic chemistry are discussed qualitatively from the standpoint of the conceptions of the electronic doublet and electronic octet (in the sense of Lewis-Langmuir) but more particularly from the recent viewpoint of pole transition. H. H. Ho.

653. Theory of Formation of Periodic Structures. E. S. Hedges. *Kolloid Zeits.* 52. *pp.* 219–222, *Aug.*, 1930.—In this summary, the author draws attention to data which are not in accord with Wo. Ostwald's diffusion wave-theory, especially the cases of periodic structures obtained with reactions where no reaction-electrolyte and no third diffusion wave are present. The author considers periodic structures (1) by means of chemical reactions, (2) by coagulation, (3) by salting out, (4) by the reaction of gases, and (5) by irreversible reactions. He states that the Ostwald theory has played and still plays a valuable *rôle* in the development of the general theory of periodic structures while not being the fundamental theory for their explanation. H. H. Ho.

654. Chain Reactions due to Physical Structure. N. v. Raschevsky. *Zeits. f. Physik,* 64. 7–8. *pp.* 556–558, 1930.—This paper continues previous work [see Abstract 2316 (1930)] and it is shown that under certain conditions substances may only be formed in a definite series and when a limiting quantity of the preceding member is present. This condition is entirely independent of the chemical nature of the particular reactions and is determined only by the interplay of the diffusion and dissolution phenomena. H. H. Ho.

655. Ammonia Synthesis and Heat of Reaction. Energy and Entropy Constants for Ammonia. L. J. Gillespie and J. A. Beattie. *Phys. Rev.* 36. *pp.* 1008–1013, *Sept.* 1, 1930.—From the two adjustable constants obtained by the authors' treatment of the data on the ammonia synthesis equilibrium, there are calculated the energy and entropy constants for gaseous ammonia referred to the energy and entropy of hydrogen and nitrogen as having the value zero at 0° C. and 1 atmosphere. The energy constant for ammonia is − 10058·1 15°-cal. per mol. and the entropy constant − 16·6491 15°-cal. per °C. per mol. Values of the usual thermodynamic function at 0° C. and 1 atmosphere are given in this system for hydrogen, nitrogen and ammonia. A rational and simple relation is given for the variation with both pressure and temperature of ΔH the heat absorbed in a chemical reaction at constant pressure in systems composed of real gases. Values of this heat are computed for several pressures and temperatures for the ammonia synthesis reaction. [See also Abstract 304 (1931) and following Abstract.] AUTHORS.

656. Optimum $H_2 : N_2$ Ratio for Ammonia Formation in the Haber Equilibrium. L. J. Gillespie and J. A. Beattie. *Am. Chem. Soc., J.* 52. *pp.* 4239–4246, *Nov.*, 1930.—By means of an improved mass-action equation which had previously been found to represent the combined effects of temperature and pressure together with such variations of composition as occurred in the displacement of equilibrium, calculations have been made of the effects of the yield of NH_3 produced by systematic variation of the ratio of H_2 to N_2. For the temperature 500° and for the pressures 100, 300, 600 and 1000 atmospheres the optimum values of this ratio, both the initial values and the values at equilibrium, were found for pure H_2 and N_2 as well as for pure H_2 and atmospheric nitrogen from which the argon had not been removed. Except at low pressures the optimum value of the ratio is less than 3. The optimum value of the initial ratio falls to 2·90 at 600 atmospheres, and that of the final ratio at equilibrium to 2·68 at 1000 atmospheres, when no argon is present. The corresponding figures are 2·91 and 2·72 when atmospheric nitrogen is used. The percentage of NH_3 at the optimum ratio exceeds that at the ratio 3 by less than 0·1 % of the percentage at 3 in any case. The presence of A is deleterious at any pressure. At 1000 atmospheres the yield when pure N_2 is used is about 0·6 % (of its value) greater than when atmospheric nitrogen is used. For the case of pure N_2, the yields of NH_3 were also calculated at the values 2, 3 and 4 at each pressure and at 500°. For comparison, the ordinary mass-action law was used to calculate the yield of NH_3 at each pressure and at the initial values 2 and 4 from the yield at the value 3, with errors which reached at 1000 atmospheres 1·5 % of the yield at 3. [See also preceding Abstract.] AUTHORS.

657. Nature of Chemical Forces. K. Fajans. *Science*, 72. *pp*. 99–107, *Aug*. 1, 1930.—This is the inaugural address of the G. Fisher Baker Non-Resident Lectureship at Cornell University, and it commences with an historical review of the subject after which the chemical and physical behaviours of polar and non-polar compounds are discussed from the standpoint of three properties, *viz.*, the type of lattice in which the substance crystallises; the ease with which it passes from the solid or liquid to the gaseous state; the ability to form ions in aqueous solution and therefore to conduct the electric current. The case of mercuric iodide is considered in detail since its behaviour is intermediate between that of hydrogen and sodium chloride, and it constitutes a transition type due to the intense deformation of the iodine ion by the mercuric ion. The recognition of transition types has enabled the adoption of a single system for all compounds which the dualistic and unitary theories attempted in vain. H. H. Ho.

658. Quantum Theory of Chemical Forces. M. Born. *Zeits. f. Physik*, 64. 11–12. *pp*. 729–740, 1930.—By means of the methods devised by Slater [see Abstract 1452 (1930)] Heitler's formulæ for the chemical forces uniting two unequal atoms [see Abstract 2976 (1930)] may be derived without the aid of the group theory. T. H. P.

659. Quantum Theory of Chemical Kinetics. Unimolecular Reactions. S. Roginsky and L. Rosenkewitsch. *Zeits. f. phys. Chem.* 10. *Abt. B*.1. *pp*. 47–85, *Sept*., 1930.—The spontaneous quantum-mechanical transitions between states with equal energies are investigated in their application to the theory of the kinetics of unimolecular reactions (1) according to the scheme of the passage across the potential energy threshold, and (2) according to a scheme analogous to the Auger effect. In both cases the dependence of the velocity constants of unimolecular reactions on the temperature is accurately represented. In addition, the latter method allows also of correct conclusions being drawn regarding the mechanism of the reaction and yields relations between the fundamental kinetic constants in good agreement with the chemical data. The conditions determining the order of the reaction are considered, and the conclusions deduced are applied to explain the kinetics of certain known reactions and to predict the order of some kinetic reactions not yet studied. The empirical relation of Cremer is only a special case of the more general equation for the kinetics of unimolecular reactions and needs no new hypothesis for its explanation. Various possible mechanisms of the oxidation reactions of molecular reactions are examined, the theory of Bach and Engler appearing the most probable. T. H. P.

660. Kinetics of Oxidation of Copper. Part I. F. J. Wilkins and E. K. Rideal. Part II. F. J. Wilkins. *Roy. Soc., Proc.* 128. *pp.* 394–406 *and* 407–417, *Aug.* 5, 1930.—Part I deals with the initial oxidation of copper at low pressures, and it is suggested that the oxidation of copper is the resultant of three consecutive processes and that its velocity depends upon (*a*) the rate of condensation of oxygen at the oxide/oxygen interface, (*b*) the rate of removal of oxygen from the oxide/oxygen interface into the oxide, and (*c*) the rate of diffusion of oxygen through the oxide. The initial oxidation at low pressures is governed by (*a*), and the equation describing the rate of oxidation is therefore $\log_e p_0/p = kt$, which, however, does not hold for the oxidation of active copper at high pressures or inactive copper at low pressures. In Part II it is found that the limiting pressure below which the oxidation of copper ceases to follow the parabolic law is the higher the more active the copper. Sintering of the surface decreased the limiting pressure. It is suggested that at the limiting pressure the grain boundaries in the surface of the cuprous oxide are just saturated with adsorbed oxygen. On this basis it is shown that the influence of activation on the limiting pressure is accounted for if it is assumed that the oxygen adsorbed on cuprous oxide at 183° C. is able to diffuse laterally. Dunn's observation that the oxidation of commercial copper at low temperatures follows the parabolic law is confirmed [see Abstract 2219 (1926)]. H. H. Ho.

661. "Explosive" Antimony. Part IV. E. Cohen and C. C. Coffin. *Zeits. f. phys. Chem.* 149. *Abt. A.*6. *pp.* 417–433, *Sept.*, 1930.—The only factors which determine the formation of explosive or non-explosive antimony from vigorously stirred solutions of antimony trichloride in aqueous hydrochloric acid are the temperature, current density and concentration of the solution [see Abstract 1971 (1905)]. The limiting values of each of these variables for explosive antimony to be formed are given and the phenomenon is found to be readily reproducible. Increase in current density favours the formation of the explosive modification and rise of temperature that of the non-explosive form; the effect of change of concentration of the solution is relatively small. Neither seeding nor the stabilisation velocity of the metastable form has any influence on the phenomenon. T. H. P.

662. Dissociation of Carbon Dioxide in the Electrodeless Discharge. H. Hunt and W. C. Schumb. *Am. Chem. Soc., J.* 52. *pp.* 3152–3159, *Aug.*, 1930.—By means of an apparatus suitable for producing a h.f. oscillatory electrodeless discharge, it is shown that the equilibrium $2CO + O_2 \rightleftarrows 2CO_2$ is established under the influence of this discharge, and data for the equilibrium at various pressures are given. Equilibrium is attained within two minutes. The results obtained by variation in the percentage composition of the gas mixtures employed are not in agreement with the law of mass action. K_p is not a constant, but decreases with increase in the value of the equilibrium pressure. Increased pressure decrease the extent of decomposition of CO_2 and increases the extent of synthesis, this being in only qualitative agreement with the law of mass action. In presence of an inert gas, such as helium, the equilibrium is displaced in the direction of increased decomposition of the CO_2. T. H. P.

663. Action of High-Speed Electrons on Methane, Oxygen and Carbon Monoxide. J. C. McLennan and J. V. S. Glass. *Canad. J. of Research*, 3. *pp*. 241–251, *Sept*., 1930.—This paper deals with the action of kathode rays on gases and gas mixtures. Methane, methane-oxygen mixtures, carbon monoxide and carbon monoxide-oxygen mixtures were examined. Methane gave small percentages of hydrogen and ethane. Methane and oxygen mixtures gave as gaseous products, carbon monoxide, carbon dioxide and hydrogen, the only other products being water and formic acid. The relative proportions of the products do not vary widely under a wide variation of conditions. The reaction was found to be of the first order with respect to pressure. The reaction rate increases linearly with the voltage up to a certain value, after which it becomes nearly independent of the voltage. The action of kathode rays on carbon monoxide produces carbon dioxide and a solid brown suboxide which is extremely soluble in water, and its composition corresponds to a formula $(C_3O)_n$. If the carbon monoxide is moist, no visible amount of solid or liquid is found and there is less carbon dioxide. Carbon monoxide-oxygen mixtures under the action of kathode rays form carbon dioxide. Presence of water vapour has a retarding effect on the reaction. For mixtures of the same composition the reaction rate is proportional to the total pressure. For dry mixtures the product increases with the carbon monoxide present; when moist it is much less, and independent of the carbon monoxide. AUTHORS.

664. Positive-Ray Analysis Applied to the Decomposition and Synthesis of Hydrocarbons in Discharge Tubes. O. Eisenhut and R. Conrad. *Zeits. f. Elektrochem.* 36. *pp*. 654–661; *Disc*., 661–662, *Sept*., 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June*, 1930.—J. J. Thomson's method of positive-ray analysis is applied to the study of the disintegration and combination of various hydrocarbon molecules in the discharge tube. The hydrocarbons investigated are methane, ethane, ethylene and acetylene. The parabolic traces obtained photographically show that in the discharge tube there is a systematic disintegration of the initial hydrocarbon molecule into all the possible simple fractions down to elements. Combination of these fractions is also observed, in some cases forming hydrocarbons which have no existence in the free state. A. J. M.

665. Precision Actinometry with Uranyl Oxalate. W. G. Leighton and G. S. Forbes. *Am. Chem. Soc., J.* 52. *pp*. 3139–3152, *Aug*., 1930.—Reinvestigation of the photolysis of certain uranyl oxalate solutions in nine approximately monochromatic radiations, with elaborate radiometric and analytical precautions, shows that the gross quantum yield ϕ at 25° C. for a solution 0·01 M in uranyl sulphate and 0·05 M in oxalic acid varies between 0·60 at 254 $m\mu$ to 0·58 at 435 $m\mu$, with a minimum of 0·49 at 366 $m\mu$. These values are about one-half of those usually adopted at the present time. The value of ϕ is diminished by sodium sulphate or hydroxide and by sulphuric acid, in spite of the fact that the first two enhance total absorption. The temperature coefficient, $\phi_{t+10} : \phi_t$, is 1·03 + 0·035 between 10° and 25°, both at 366 $m\mu$ and at 313 $m\mu$. If the light presumably absorbed by uncombined uranyl sulphate is subtracted before calculating ϕ for solutions containing no great excess of oxalic acid, ϕ becomes nearly independent of their concentrations. These calculations support the view that the photolyte is $UO_2HC_2O_4^+$ or $UO_2C_2O_4$ or some optical cluster equivalent to one of these and render it improbable that the photolysis depends mainly on collisions of the second kind between excited UO_2^{++} and $H_2C_2O_4$. Detailed suggestions are given for actinometry in monochromatic and polychromatic light, the limitations of the latter being indicated. T. H. P.

666. Photochemical Dissociation of Nitrogen Peroxide. L. H. Dawsey. *Nat. Acad. Sci., Proc.* 16. *pp.* 546–552, *Aug.,* 1930.—The absorption spectra of nitrogen dioxide and nitrogen tetroxide have been photographed at room-temperature and that of liquid air respectively, and a comparison is made with previous work [see Abstract 394 (1930)]. The conclusion is drawn that the primary photochemical decomposition in nitrogen peroxide is due to the tetroxide constituent. The threshold for complete photochemical equivalence is calculated to be at about 3800 Å. The mechanism $N_2O_4 \xrightarrow{h\nu} 2NO + O_2('S)$, is proposed to account for the primary photochemical dissociation, and the continuous absorption spectrum of N_2O_4. The energy changes involved agree closely with thermal data. H. H. Ho.

667. Second Report of the Committee on Photochemistry, National Research Council. H. S. Taylor. *J. Phys. Chem.* 34. *pp.* 2049–2091, *Sept.,* 1930.—This second report is a systematic analysis of the total photoprocess and is divided into two main parts: that dealing with the initial process of quantised absorption, the primary absorption process, and then with the succeeding secondary process of chemical change. The report is confined entirely to photo-reactions in gaseous systems, and includes as much of the older work as is necessary to illustrate the mode of treatment of photo-reactions from the above-mentioned considerations. R. C. F.

668. Photochemical Reaction between Oxygen and Hydrogen Chloride. A. J. Allmand and R. G. Franklin. *Chem. Soc., J. pp.* 2073–2092, *Sept.,* 1930.—The photochemical oxidation of concentrated aqueous hydrochloric acid solutions by dissolved oxygen has been studied and the reaction found to take place in ultra-violet light of wavelength 254–365 $\mu\mu$. At 260 $\mu\mu$ the quantum efficiency is of the order of 0·2, and falls off rapidly at longer wave-lengths. The chlorine concentration produced is limited by the setting up of a stationary state, determined by the equality of two opposing photochemical reactions. Ultra-violet light can both form and destroy chlorine under these conditions, whilst visible light can only effect the latter reaction. The chlorine concentration at the stationary state is lower the lower the concentration of the acid. The oxidation of gaseous hydrogen chloride by oxygen takes place solely in ultra-violet light under laboratory conditions, goes to practical completion in sunlight, and is sensitised by chlorine and retarded by the removal of water vapour. It is suggested that in reality the oxidation takes place in a liquid film on the surface of the vessel. If concentrated aqueous acid also be present, a complex stationary state involving both liquid and "gaseous" reactions is set up in sunlight. Dilute solutions of chlorine in concentrated aqueous hydrochloric acid or lithium chloride behave anomalously on change of concentration, in respect both of their extinction coefficients and of their chlorine partial pressures. H. H. Ho.

669. Atomic Hydrogen. Part II. Action of Ultra-Violet Light on Pentane. A. Klemenc and F. Patat. *Zeits. f. phys. Chem.* 149. *Abt.A.* 6. *pp.* 449–464, *Sept.*, 1930.—The photochemical reactions of pentane, in which polymerisation occurs and also hydrogen is split off from the molecule, are studied quantitatively. The polymerisation products absorb oxygen very readily in ultra-violet light, the absorption being followed by a separation of CO. The removal of hydrogen from pentane and also the oxidation of hydrogen and of CO proceed in the absence of mercury, but in the first two cases the reaction is markedly sensitised by mercury. The combustion of CO to CO_2, on the contrary, is apparently quite unaffected by the mercury; this reaction is ascribed to activation of the oxygen by the ultra-violet light. The possibility of dissociation of the oxygen molecule in this case is discussed with reference to the strong absorption in the region 1950 Å. and the work of dissociation. [See also Abstract 3433 (1929).] A. J. M.

670. Photochemical Reaction of Hydrogen and Carbon Monoxide in Presence of Activated Mercury Atoms and the Photo-Identification of the Reaction Products. W. Frankenburger (in Collaboration with H. Klinkhardt, C. Steigerwald and W. Zimmermann). *Zeits. f. Elektrochem.* 36. *pp.* 757–768; *Disc.*, 768–769, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June,* 1930.—Mixtures of hydrogen and carbon monoxide react photochemically at ordinary pressures and temperatures in presence of activated mercury atoms by absorption of the line 2536 Å. with formation of formaldehyde and glyoxal. The yields obtained vary with degree of purity, velocity of flow, mixture ratio and temperature, as well as with concentration and degree of activity of the metallic vapour, but attain an upper limiting value by a suitable choice of experimental conditions. Within the optimum conditions, the ratio of quantum yield expressed as number of aldehyde groups produced to number of absorbed quanta at 2536 Å. is approximately constant and lies between 1 and 1·5 for different sources of radiation. From the data obtained, the conclusion is drawn, contrary to that of Marshall, that no chain reaction takes place but direct formation of glyoxal and formaldehyde from H-atoms and HCO-radicles. The negative temperature coefficient indicates a very small heat of formation of the radicle HCO from H and CO, which is in agreement with the result from the band spectra. Relatively high concentrations of the intermediate products especially in proximity to the radiation walls lead to secondary reactions. H. H. Ho.

671. Influence of Drying on the Photolysis of Carbon Dioxide. A. Coehn and T. Spitta. *Zeits. f. phys. Chem.* 9. *Abt. B.* 6. *pp.* 401–425, *Sept.*, 1930.—An optimum moisture content is necessary for the decomposition of carbon dioxide by ultra-violet light, whereby (under 300 mm. mercury) the photolysis amounts to about 20 %. Small variations on either side of the optimum moisture content lower the photolysis. Very full experimental details are included. H. H. Ho.

672. Optical Dissociation of Mercury 2-Bromide. G. Jung and W. Ziegler. *Zeits. f. phys. Chem.* 10. *Abt. B.* 1. *pp.* 86–88, *Sept.*, 1930.—Under the influence of light of wave-lengths 350–210 $\mu\mu$, mercuric bromide vapour is decomposed into a normal mercurous bromide molecule and a normal bromine atom. The work of dissociation of the process $HgBr_2 = HgBr + Br$ is 80 cal. T. H. P.

673. Overpotential of Metals. P. Sederholm and C. Benedicks. *Am. Electrochem. Soc., Trans.* 56. *pp.* 169–183; *Disc.*, 183–186, 1929.—The reversibility of the regular, half-immersed, hydrogen electrode was established, even within the region of oxygen discharge, with anodic currents below one milliampere. A special apparatus was designed for determining the overpotential of a given metal possessing a varying, well-defined geometrical curvature. Mercury was used as a kathode in the preliminary measurements. Smooth and platinised platinum electrodes were used in later work. Curves were obtained which showed the equilibrium potential of the oxygen electrode. A theory of overpotential is put forward, and its nature discussed. F. J. B.

674. Potentials of Copper Anodes and Kathodes. E. F. Kern and R. W. Rowen. *Am. Electrochem. Soc., Trans.* 56. *pp.* 379–392; *Disc.*, 392–395, 1929.—The potentials of copper anodes and kathodes were determined, and the effect upon the potentials by varying the temperature and the composition of the electrolyte, by the composition and physical character of the anodes, and by the additions to the electrolyte of glue and sulphite-waste residue in the proportions usually added to copper refining electrolytes. The static potentials of copper anodes and kathodes were found to be practically identical in the same cells; whereas the dynamic potentials and the polarisation potentials varied, and were dependent upon circulation and temperature of the electrolyte, composition and physical condition of the electrodes, and upon the presence of glue and of sulphite-waste residue, in the amount usually added to copper-refining electrolytes. A comparison of the results obtained by the use of the Haring polarisation and resistivity cell, by means of a saturated calomel half-cell, and a mercurous sulphate half-cell, showed that the most satisfactory results were obtained by the saturated calomel half-cell in connection with a potentiometer. AUTHORS.

675. Potentials and Electrode Efficiencies of Copper. G. M. Smith and J. M. Breckenridge. *Am. Electrochem. Soc., Trans.* 56. *pp.* 397–404; *Disc.*, 405–408, 1929.—This paper gives a record of the kinetic potentials of a copper kathode, using various current densities and different concentrations of copper cyanide in sodium cyanide. Electrode efficiencies are given in various concentrations of the electrolyte, and at different current densities. [See also Abstract 836 (1927).] AUTHORS.

676. Tantalum as Kathode for the Electrodeposition of Copper. L. W. Strock and H. S. Lukens. *Am. Electrochem. Soc., Trans.* 56. *pp.* 409–418; *Disc.*, 418–420, 1929.—Tantalum has been found to be a satisfactory kathode material in place of platinum for electro-analytical determinations. It was noted that the Ta kathode surface became darker in colour and increased in weight after each deposition and cleaning cycle. This increase in weight was found to be due to the formation of an oxide film produced by the nitric acid. This oxide film must be mechanically removed with an abrasive to insure good adhesion and concordantly good results. A high-starting current density (3 amp./sq. dm.) insures even distribution of the Cu on the Ta kathode. Details of procedure are given. AUTHORS.

677. Chloroplatinate-Chloroplatinite Electrode. E. R. Smith. *Bureau of Standards, J. of Research,* 5. *pp.* 735–740, *Sept.,* 1930.—A platinum electrode immersed in $0 \cdot 1N$ KCl solution containing a mixture of potassium chloroplatinate and potassium chloroplatinite has a definite e.m.f. corresponding to the electrode reaction $PtCl_4^{--} + 2\,Cl^- = PtCl_6^{--} + 2e^-$. This e.m.f. was measured against the $0 \cdot 1N$ calomel electrode and extrapolated to pure $0.1N$ KCL solution. The experimental results show that this electrode functions reversibly. AUTHOR.

678. Influence of Solvent on E.M.F. of Silver-Silver Halide Cells. A. S. Afanasiev. *Am. Chem. Soc., J.* 52. *pp.* 3477–3483, *Sept.,* 1930.—The method of preparing silver-silver halide electrodes was studied and it was found that the method of Noyes and Ellis gave the best results. Measurements were made on the e.m.f. of the cell Ag/AgCl, $KCl(C_1)/KBr(c)AgBr/Ag$, in water solution and in solutions in ethyl and methyl alcohol water mixtures of various concentrations. The results obtained showed that Nernst's osmotic theory would be applied to non-aqueous solutions. F. J. B.

679. Boundary Layer of Dilute Electrolytes. M. Planck. *Preuss. Akad. Wiss. Berlin, Ber.* 20. *pp.* 367–373, 1930.—The two different formulæ deduced by the author and Henderson [see Abstract 3207 (1929)] are discussed further, the simple case of two electrolytes with a common ion being considered. T. H. P.

680. Electrokinetic Potential. H. Lachs and J. Biczyk. *Acad. Polonaise Sci. et Lettres, Bull.* 6*A*–7*A*. *pp.* 360–375, *June–July,* 1930. *In English.*—In this paper the method of streaming potential measurements has been used and special devices for accuracy are described, since the electrical currents to be observed are very feeble. The streaming potential of water has been shown to depend to a high degree on the conductivity of water produced by the contents of carbon dioxide. The data for solutions of LiCl, KCl, RbCl and CsCl have been obtained and the corresponding electrokinetic potentials calculated; it is shown that the maximum values, when comparing the activity of salts at equal concentrations, exist at a concentration of about $3 \cdot 10^{-4}$ mol., a serial order corresponding to the lyotropic series of kations being observed. H. H. Ho.

681. Osmotic Coefficients and Chemical Structure of Ions. Part II. L. Ebert and J. Lange. *Zeits. f. phys. Chem.* 149. *Abt. A.* 5. *pp.* 389–407, *Aug.,* 1930.—This work refers to a thermoelectrical apparatus for freezing-point measurements of dilute electrolyte solutions. The lowering of the freezing point of dilute salt solutions (up to approx. $C = 5 \cdot 10^{-3}$) is measured by a cryoscopic precision apparatus wherein temperature differences are thermoelectrically and the salt concentrations conductively measured. As examples standard measurements are given of sodium chloride solutions from C = 0·005 to 0·07. The apparatus works on the equilibrium method, *i.e.*, the solution is first mixed with 50 % ice and analysed after the attainment of equilibrium. During the measurements the apparatus is immersed in ice and evacuated. [See also Abstract 1384 (1929).] J. K.

682. Relationship between Charge and Magnitude of Ions. G. v. Hevesy. *Zeits. f. phys. Chem.* 149. *Abt. A.* 6. *pp.* 472–474, *Sept.*, 1930.—The relationship of the diffusion coefficient of inorganic ions and their valency was examined. The diffusion coefficient is inversely proportional to the valency for inorganic ions, and the data are examined to see how far this relationship holds. A good degree of agreement is found between the diffusion coefficient, calculated from valency data, and the observed values. F. J. B.

683. Electrolytic Transfer of Platinum Metals Using Fused Chlorides. R. H. Atkinson. *Faraday Soc., Trans.* 26. *pp.* 490–496, *Aug.*, 1930.—The electrolysis of a ternary mixture of the chlorides of lithium, sodium and potassium, to which was added a double chloride of a platinum metal, at 400° to 500° C., resulted in the deposition of platinum, palladium, rhodium and iridium at the kathode. An impure ruthenium anode dissolved readily, but very little ruthenium was deposited. The anode and kathode efficiencies were high for rhodium and palladium. Mineral platinum can be refined in two stages, (1) melting to remove iron, (2) electrolytic refining to remove palladium, iridium, rhodium and ruthenium. F. J. B.

684. Formation of Free Hydrogen Atoms by Kathodic Polarisation of Metals. N. Kobosew and N. I. Nekrassow. *Zeits. f. Elektrochem.* 36. *pp.* 529–544, *Aug.*, 1930.—The phenomenon of overpotential is analysed thermodynamically, and an equation was developed which connected overpotential with the energy of fixation of the hydrogen atom to the metal, and with the hydrogen-ion concentration. It is shown for nine metals, platinum (polished), platinum (platinised), palladium, nickel, copper, tin, lead, mercury, that a complete parallelism exists between the overpotential of the metal and the emission of hydrogen atoms from their surfaces. It is also shown that the emission of free hydrogen atoms from the metal kathode leads to a satisfactory explanation of several peculiarities which had been observed in electrolytic reductions carried out with kathodes of different metals. F. J. B.

685. Theory of Covering Polarisation. W. J. Müller. *Zeits. f. Elektrochem.* 36. *pp.* 679–686, *Sept.*, 1930. *Paper read before the Deut. Bunsen Gesell., Heidelberg, May–June,* 1930.—A theory of passivity is developed which utilises the conception of a surface covering polarisation as a basis. Certain metal anodes show an abnormal polarisation in the first stages, which depends upon the fall of potential in the surface layer. The fall of potential is proportional to the thickness of the layer, inversely proportional to the conductivity of the pores, and to a value which represented the uncovered base metal. The theory is applied to polarisation phenomena and the passive state. The oxide layer, the oxygen theory and the metal theory are considered in relationship to the surface layer polarisation, but none of them forms a satisfactory explanation of the complicated phenomenon. F. J. B.

686. Electrolytic Resistance with Alternating Currents. S. Ray. *Zeits. f. Elektrochem.* 36. *pp.* 545–550, *Aug.*, 1930.—Mainly a mathematical treatment of the subject, in which cataphoretic conduction, conduction by ions, slow (and rapid) change of the e.m.f. with time, the (velocity)^2 law of frictional resistance, and the experimental position [see Banerji, Abstract 2492 (1926)] are considered. T. H. P.

687. Determination of the Salinity of Sea Water by the Electrical Conductivity Method. F. Wenner, E. H. Smith and F. M. Soule. *Bureau of Standards, J. of Research*, 5. *pp.* 711–732, *Sept.*, 1930.—The apparatus consists essentially of a Wheatstone bridge, conductivity cells of a type which may be filled and emptied during fairly rough weather, and the necessary auxiliary equipment, all built into a single cabinet. A special feature is the use of two similar conductivity cells in adjacent arms of the bridge. When both are filled with samples of sea water, even though not of the same salinity, both have very nearly the same temperature coefficient, so the balance of the bridge is not greatly affected by small uncertainties of the temperature. Further, the complicated actions taking place at the electrodes, generally referred to as polarisation, are substantially the same in both cells, so the effects of polarisation are largely neutralised. A further special feature, not really a part of the equipment but of a plan for its use, is that a supply of standard sea water or sea water of which the salinity has been determined by laboratory methods is carried aboard and used for periodic standardisations. Samples of sea water to be tested, together with a sample of standard sea water, are substituted one after another in the same conductivity cell. This gives a direct comparison of the sample of unknown salinity with that of a standard, almost if not quite independent of the cell constant, largely independent of other constants of the equipment and largely independent of systematic errors. AUTHORS.

688. Conductivity of Water Subjected to X-Rays. R. Schnurmann. *Zeits. f. phys. Chem.* 150. *Abt. A.* 2. *pp.* 110–114, *Sept.*, 1930.—It is shown that pure water does not give a substantial deviation in conductivity when subjected to X-rays when radiated through platinum windows in contradistinction to the work of Risse [see Abstract 2202 (1929)], who showed that the action of X-rays on water led to a decrease in value. According to theory, an increase in conductivity following the action of X-rays is not to be expected. The apparatus employed is described. J. K.

689. H.F. Conductivity of Strong Electrolytes in Aqueous Sugar Solutions. S. Mizushima and H. Sack. *Phys. Zeits.* 31. *pp.* 811–815, *Sept.* 15, 1930. *Paper read before the Deut. Phys. Gesell., Halle, June,* 1930.—This paper described conductivity measurements of magnesium sulphate in aqueous sugar solutions at frequencies of about 4×10^8 hertz, and also comparative measurements with potassium chloride. The work is supplementary to similar work on colloids with very large charged particles, hence the choice of sugar solutions for purposes of varying the viscosity, the range being from pure water to 40 % sugar. The data are explicable on the Debye theory of electrolytes. H. H. Ho.

690. Conductivity of Aqueous Solutions of Electrolytes in the Presence of Cane Sugar. H. Possner. *Ann. d. Physik*, 6. 7. *pp.* 875–902, *Oct.* 8, 1930.—The effect of concentration and voltage on the conductivity of electrolytes in the presence of cane sugar in aqueous solution was investigated. The effects of concentration and of the mobilities in the presence of sugar were determined. The characteristic property of the cane sugar solutions, which were used as the solvent for the electrolytes, was their high viscosity, which in the limit for saturated solutions was 250 times that of water. The equivalent conductivity was found to obey the square root law of Kohlrausch up to relatively high concentrations. The voltage effect showed a good agreement with the theory of Onsager and Blumentritt, up to the limits obeyed by the square root law. At higher concentrations and in stronger fields, large deviations were encountered. Electrolytes in sugar solutions were considered particularly suitable for the proof of the Debye-Onsager Theory. F. J. B.

691. Strong Electrolytes. R. Dufour. *Soc. Franc. Élect., Bull.* 10. *pp.* 1080–1095, *Oct.*, 1930.—The failure of strong electrolytes to conform to the classical theory of Arrhenius is examined and discussed. The dilution law of Ostwald is considered for a number of strong electrolytes and the curves obtained by experiment are contrasted with those calculated from the law. Osmotic properties, derived from the conductivity and from cryoscopic measurements, are contrasted, and a theory of the structure of a solution of ions is developed. In some cases agreement between theory and experiment is obtained by assuming complete dissociation of the salt in solution. F. J. B.

692. Dissociation of Strong Electrolytes in Non-Aqueous Solution. R. Schingnitz. *Zeits. f. Elektrochem.* 36. *pp.* 861–874, *Oct.*, 1930.—A discursive summary of published work on this subject. T. H. P.

693. Electrodeposition of Nickel. Part II. Effect of Current Density and Temperature. Part III. Effect of Small Quantities of Iron and Aluminium. J. B. O'Sullivan. *Faraday Soc., Trans.* 26. *pp.* 533–543, *Sept.*, 1930.—The effect of current density and temperature on the surface structure of nickel deposits, and the influence of small quantities of iron and aluminium on the deposition were investigated. The varied surface structure of nickel deposits prepared from buffered nickel sulphate solutions were shown to be due to variations in the throwing power of the solution. The deposition potential was measured over a moderate range of current density, of which it was shown to be a logarithmic function. Small quantities of iron were found to be without appreciable effect on the deposition of nickel. Aluminium was found to accumulate in the kathode film until colloidal compounds were formed. If this proceeded the deposit became black or "burnt." This phenomenon was considered to be due to the co-precipitation of colloidal aluminium compounds. [See also Abstract 2706 (1930).] F. J. B.

694. Minimum Voltage to Reduce Aluminium Oxide. A. B. Newman and G. G. Brown. *Indust. and Engin. Chem.* 22. *pp.* 995–1000, *Sept.*, 1930.—The specific heat of crystalline alumina has been determined by a method involving the diffusion of heat through a cylinder of the powdered material. The results of this determination have been combined with the thermodynamic properties of alumina as given in the literature to compute the minimum theoretical voltage required to reduce alumina to molten aluminium and gaseous oxygen. It is probable that this value is reduced in the commercial process by oxidation of the carbon anode. Making allowance for this reduction in potential, the theoretical minimum voltage at 950° C. is computed to be 0·947. AUTHORS.